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Southwestern
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Report No. 2
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Cultural Resources Management

High Altitude Adaptations In The Southwest

Joseph C. Winter, Editor

HIGH-ALTITUDE ADAPTATIONS IN THE SOUTHWEST

Edited By

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CULTURAL RESOURCES MANAGEMENT REPORT NO. 2

USDA Forest Service
Southwestern Region

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FORWORD

It is always satisfying to see the results of cooperative efforts made available to managers and public alike. This volume represents a diversity of cooperation between Federal and State agencies and the private sector. The idea for a High-Altitude Conference arose with Dr. Douglas Swartz of the School of American Research in Santa Fe. He invited the Forest Service to organize the conference since most high-altitude land is managed by our agency. We invited the Bureau of Indian Affairs and the State Historic Preservation Office to join us. With contributions, financial and otherwise, from all four groups, the conference was held at the School of American Research facility in Santa Fe, with the results reported in this volume.

I am pleased not only with the cooperative effort, but with the participation of the scholars involved. Dr. Joseph Winter as chairman of the conference and editor of these results is especially commended. The variety of papers should hold something of interest for many different readers. Articles on cultural resource management are provided by Dee Green, Evan DeBloois, and Bruce Harrill. Adapting to high-altitude environments is discussed by Joseph Winter and Richard Hevly. Fred Plog and Evan DeBloois provide overviews of high-altitude human adaptations for Arizona and Utah respectively. Edmund Ladd covers modern Native American use with John Broster and Emily Abbink discussing historic anglo occupations.

A series of specific research projects are covered in papers by James Muller and Mark Steiger, Joseph Winter, John Broster, David Stuart and Robin Farwell, and John Broster and Bruce Harrill. Geographical coverage includes Arizona, Colorado, New Mexico, and Utah.

The Southwestern Region of the Forest Service is pleased to offer this publication as a part of its continuing commitment to the wise management of our important heritage resources.

PAUL D. WEINGART
Director of Recreation
USDA Forest Service
Southwestern Region

ACKNOWLEDGEMENTS

This report and the advanced seminar on "High-Altitude Adaptations in the Southwest" that it is based on were made possible through the support of the School of American Research, the Southwest Regional Office of the U. S. Forest Service, the Albuquerque Office of the Bureau of Indian Affairs, and the State Historic Preservation Office. I would like to thank Doug Schwartz at the School of American Research for hosting the seminar, and Dee Green, Bill Allan, and Tom Merlan for encouraging the Forest Service, BIA, and SHPO to financially support the seminar and report. I would especially like to thank Dee Green for asking me to serve as chairman of the seminar and editor of the report. Dee's work in arranging the publication of the report and in final proofing is also gratefully acknowledged.

PART ONE: THE MEANING AND MANAGEMENT OF HIGH-ALTITUDE CULTURAL RESOURCES: PRELIMINARY VIEWS

INTRODUCTION: HIGH-ALTITUDE RESOURCE USE IN THE SOUTHWEST

Joseph C. Winter

INTRODUCTION

High-altitude elevations, which range from approximately 2500 meters (8200 feet) to 4380 meters (14,366 feet) in the Southwest (Figure 1), form an important zone of exploitation. Most prehistoric and historic cultures, from the PaleoIndian, Archaic, Mogollon, and Anasazi on up through the Pueblo, Athabascan, and Euro-American groups have utilized the resources of higher elevations. These zones represent some of the most inhospitable and marginal locations in the Southwest, yet they contain lithic materials, large game, forage, spiritual power, minerals, and other resources that have long been of extreme importance to the region's cultures. The overall purpose of the School of American Research's Advanced Seminar on "High-Altitude Adaptation in the Southwest" and this resulting volume of papers was to explore the role of high-altitude resource use in the development of Southwestern cultures. A related purpose was to understand the challenge of cultural resource management at high elevations.

CONCEPTS

There are four overriding considerations in the study of the human use of high-altitude environments. The first involves the physical limitations of mountains, plateaus, and similar areas with elevations over 2500 meters above sea level. Weather patterns, a reduced oxygen level, limited plant and animal distributions, and a short growing season are major environmental factors. The second consideration concerns the biological effects of high elevations on human populations. The effects of hypoxia (i.e., a reduced level of oxygen) are the main biological constraints upon high-altitude human activity. Third, the range of cultural adaptations that humans have developed to survive at high elevations is a critical consideration. These adaptations vary from the agricultural and pastoral techniques that many cultures have developed to allow permanent, year-round use, through the seasonal visits of hunters and gatherers, to the very specialized, short-term uses of most cultures. Finally, competition over the use of high-altitude resources by various cultures is the fourth consideration. This competition obviously involves materials, timber, water, and other natural resources, but it also entails the management and exploitation of archeological sites and other cultural resources that are of value to various ethnic groups. The following discussion briefly summarizes these four considerations and sets the baseline for the papers in this volume.

Environmental Considerations

High elevations constitute large parts of the Southwest in the States of New Mexico, Colorado, Arizona, and Utah (Figure 1). They include ranges of the middle and southern Rocky Mountain system, such as the San Juans in Colorado, the Wasatch and Uintas in Utah, and the Sangre de Cristos and Jemez Mountains in New Mexico. The Wasatch, Uintas, and Sangre de Cristos are anticlinal in nature, while the San Juans and Jemez are volcanic in origin. Volcanic and other igneous mountains are also present along the margins of the Colorado Plateau. These include domal structures such as the Henrys, Abajos, Manti-LaSals, and Navajo Mountain in Utah, and Sleeping Ute Mountain in Colorado. Volcanic peaks are represented by Mt. Taylor in New Mexico and the San Francisco Peaks in Arizona.

While much of the Colorado Plateau proper lies below 2500 meters, the High Plateaus to the north of the Grand Canyon are between 3000 and 3500 meters in elevation. The Zuni Mountains, the Chuskas, and several high mesas on the southeastern Colorado Plateau also attain heights over 2500 meters.

Finally, a large part of the Southwest is composed of fault block mountains, in the Basin and Range Province. Scores of these

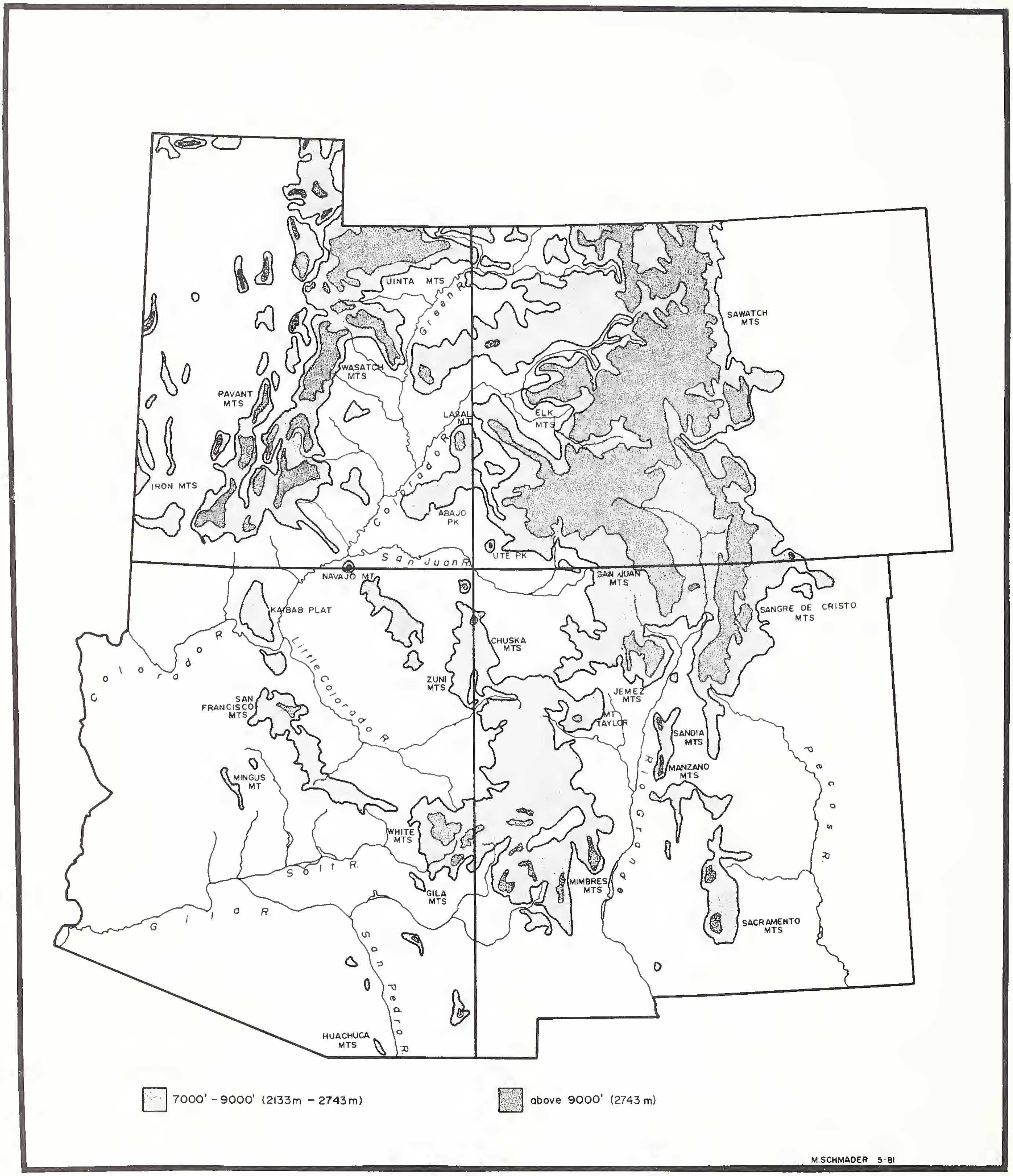

Figure 1. High-Altitude Regions in the Southwest.

isolated, north-south trending ranges are scattered throughout New Mexico, Arizona, and Utah. They include the Sandias, Manzanos, and Mimbres in New Mexico, and the Gilas, Huachucas, and Mingus Mountains in Arizona, and the Iron and Pavant Ranges in Utah.

Temperature, exposure, surface features, and their factors interact to produce a variety of different high-altitude environments, but all highlands in the Southwest share a number of common features. Reduced atmospheric pressure is the common denominator of all such environments. The barometric pressure decreases by one-thirtieth for every 290 meters increase in elevation, so there is approximately 23 percent less oxygen available at an elevation of 2500 meters than at sea level. Temperature also falls regularly with elevational increases. At 2500 meters the temperature averages 6.4°C lower than at nearby areas at 1500 meters elevation, and 12.8°C lower than at areas at 500 meters in elevation (Strahler and Strahler 1973:84). This difference has obvious consequences for farmers and wild plant gatherers, since it would shorten the growing season considerably. Figure 2 illustrates the mean frost-free season for the Southwest. It clearly shows that high-altitude areas in the region are generally beyond the limits of corn agriculture, which is essentially based on a 120-day frost-free season.

The effects of a short growing season are equally dramatic for hunters, whose body heat loss is a critical factor in mountain environments. Heat is lost by longwave radiation, by conduction to surrounding cool air, by loss of latent heat through evaporation, and by loss of heat from the lungs in respiration. Even with perfect clothing the loss of heat by respiration can be critical. For example, when weight is held constant, 30 kilocalories more heat is lost in respiration at an elevation of 4500 meters than at 150 meters above sea level (Little and Hanna 1978:228).

In contrast to oxygen and temperature which decreases with elevation, ionizing radiation increases dramatically, as less radiation is reflected by the thinner atmosphere. There is almost four times the amount of ionizing radiation at an elevation of 3050 meters than at sea level (Strahler and Strahler 1973:84). The burning effect of sunlight is heightened, especially in the generally cloudless skies of the Southwest.

A final oxygen-related factor at high elevations involves the boiling point of water, which affects cooking and sanitation. At 2500 meters the boiling point is 90.9°C, versus 94.6°C at 1500 meters, and 100°C at sea level. Although water boils at a lower temperature in the highlands, cooking time is increased.

Weather patterns are obviously influenced by the lower temperatures, shorter frost-free season, and other aspects of high-altitude areas. The humidity is generally less than at nearby lower elevations, but precipitation, air turbulence, and wind flow are generally greater. Southwestern high altitudes experience much greater amounts of precipitation than nearby lowlands (Figure 3). Most precipitation falls in the summer, as heavy afternoon thunderstorms produced by local orographic convective activity. Winter precipation generally takes the form of snow; due to low temperatures, up to several meters may accumulate in the higher mountains. Small glaciers and ice fields are present in a number of the ranges.

In addition to the generally lower temperatures in high elevations (relative to low elevations), there is also less seasonal variation in temperature, yet more diurnal variation, due to the high levels of long wave, thermal infrared radiation that accumulate during the day and escape at night. Diurnal wind patterns are a related factor, as daytime heating of the air over the mountains creates local pressure gradients towards the highlands. A mountain breeze often results, and air moving towards the mountains is forced up the slopes and down the leeward side. At night the pattern is reversed, with the air flowing down as a valley breeze.

The prevailing winds and orographic rainfall are important weather factors for high elevations in the Southwest. The prevailing winds blow predominantly from a southwesterly quarter, with distinct seasonal alterations in pressure and direction. In the summer there is a tendency for air to move from the Gulf of Mexico and Gulf of California northeast across the continent. In winter, however, the tendency is for movement southward from Canada. Cyclonlic and frontal precipitation are associated

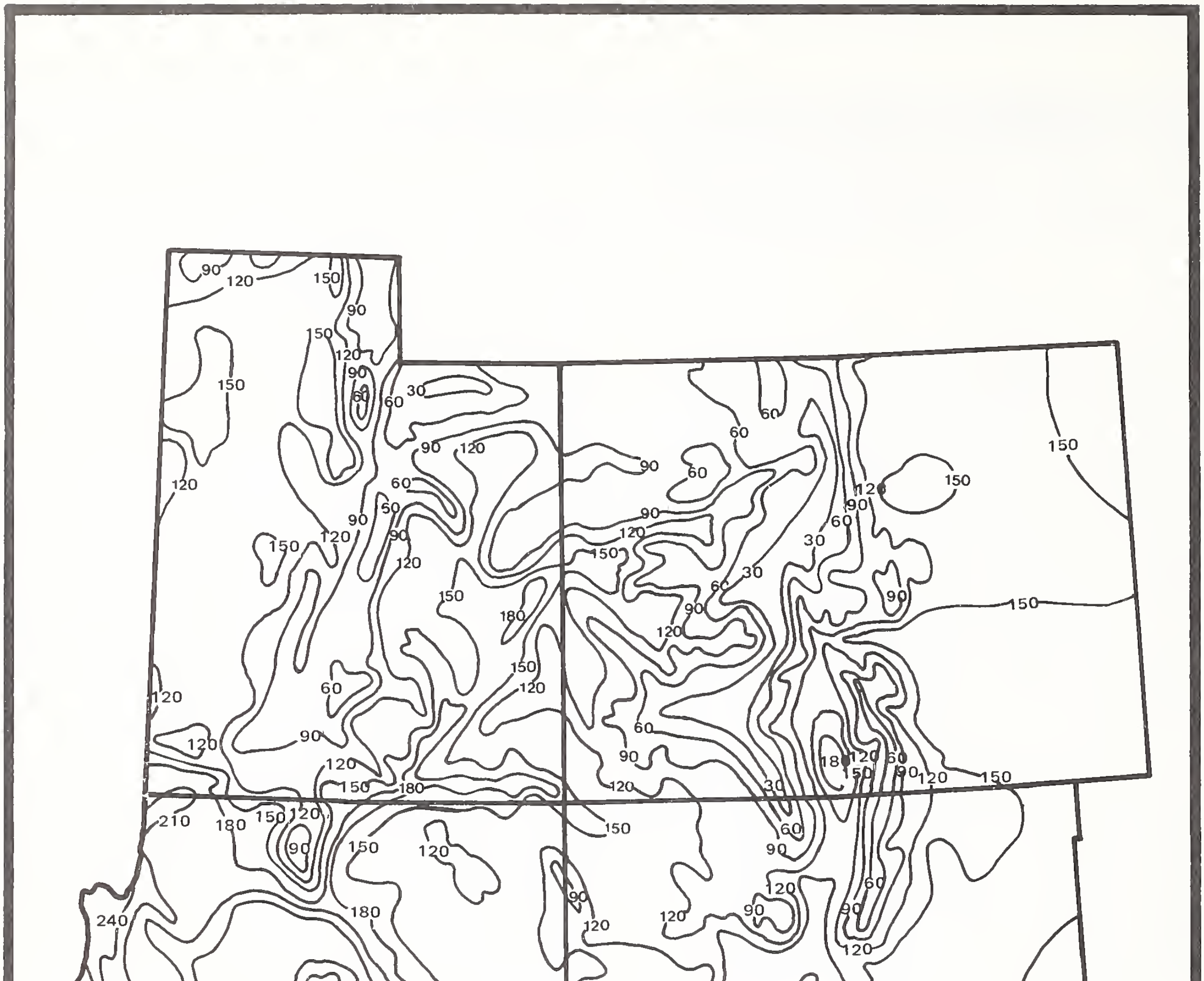

Figure 2. Mean Frost-Free Season in the Southwest.

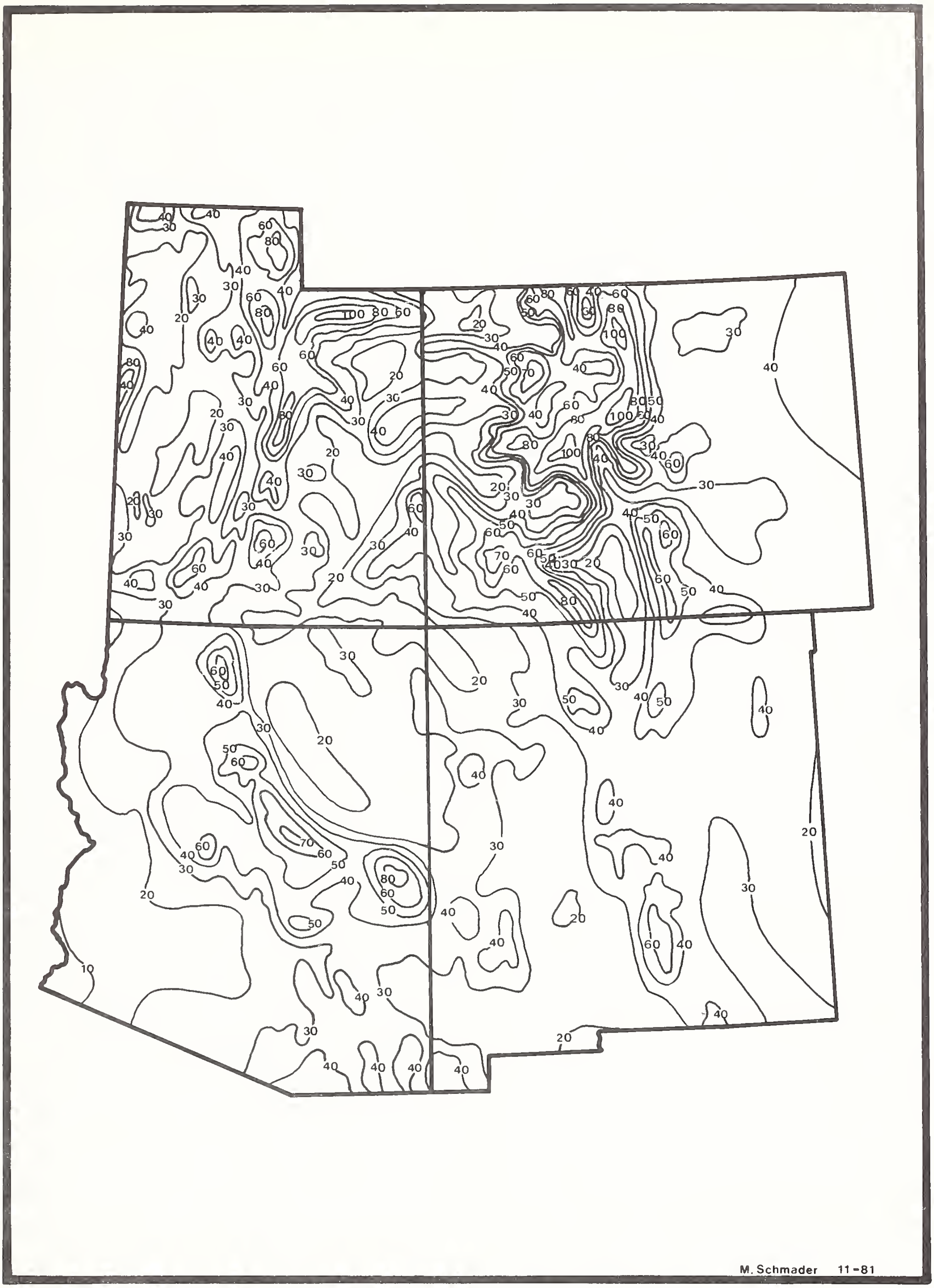

Figure 3. Mean Yearly Precipitation in the Southwest.

phenomena. Northern Arizona and New Mexico are in one of eight common tracks of mid-latitude cyclones that pass from west to east across the United States (Ibid:130). They are often associated with torrential rainstorms, snowstorms, hail, and lightning.

The prevailing winds are very important environmental factors, particularly for plants. They represent large movements of water-laden air masses. Precipitation occurs when these masses rise to higher elevations and experience a drop in air temperature due to a decrease in air pressure. Thunderstorms often result, especially in mountainous regions where orographic rainfall is common. Air masses moving with the prevailing westerlies are forced up and over the mountains, and they cool as they rise, with condensation and precipation occurring on the windward side. Lightning is often associated with this convective cell activity.

The floral and faunal resources and their seasonal availability are very significant environmental considerations. Many species of hardwoods, conifers, annuals, forbs, and other plant taxa that are not present in lowlands are available in the mountains, while others are present at different times of the year and for longer or shorter periods. High elevation meadows provide excellent forage for deer, elk, cattle, and sheep, while brush covered slopes and young successional communities are sources of browse. Important faunal species that are present in the Southwestern highlands include deer, elk, bighorn sheep, bear, and cougar. Many mountains are summer calving grounds and autumn breeding areas for elk. Bighorn sheep live in the mountains year round, but at different elevations depending on the season. From late fall to early spring both the ewe and ram bands are closely congregated in lower mountain ranges for the fall rut and the spring lambing season. However, from late spring to early fall they disperse to the high mountains (Wright, Bender, and Reeve 1980:193).

Many Southwestern highlands also contain significant lithic, mineral, and geothermal resources. The volcanic ranges, such as the Jemez Mountains, are rich in obsidian, ryolite, andesite, and basalt, while many of the metamorphic ranges contain chert, chalcedony, quartzite, and other valuable lithic materials. Turquoise, gold, silver, lead, and other minerals are available in certain ranges, and even uranium is present in sedimentary formations beneath and around several high-altitude areas, such as Mt. Taylor. Geothermal energy occurs in certain of the more recent volcanic ranges, such as the Jemez Mountains.

The final resource that is available in Southwest highlands is the most difficult to quantify and analyze, since it involves the spiritual properties and religious "powers" attributed to many mountains by the Navajo, Pueblo, and other Native American cultures. Mountains figure in many emergence myths, and they are the homes of the kachinas and other spirits; in fact, they are often considered spiritual beings. Mountains often contain or represent shrines and boundary markers, and they are important ritual locations. These properties are rarely manifested archeologically, but they are often the source of land use conflicts between Indian groups and energy developers.

Biological Considerations

Recently there has been considerable research by the International Biological Programme, the World Health Organization, and other institutions concerning the adaptive fitness of high-altitude populations, the acclimatization of lowlanders, and the general health problems of highland environments (Baker 1978a). Paul Baker and other participants in the International Biological Programme study of the biology of highlanders have defined high-altitude populations as those that live permanently above 2500 meters above sea level (Baker 1978b:317; Pawson and Jest 1978:18). Although there is no absolute demarkation between "high" and "low" elevations, in that there is actually a continuum of environmental change, the 2500 meter elevation was selected since most humans experience some physiological effects beyond this point. Some changes, such as in night vision, commonly occur at 1500 meters; others, such as severe respiratory stress, generally do not occur until 3000 meters. Significant hypoxic stress, however, is often experienced by lowlanders at the 2500 meter elevation. Ascent to this height produces a pronounced reduction in health, often with headaches, poor sleep, nausea, chills, a decline in many motor, cognitive, and perceptual abilities,

and other symptoms. For some individuals these effects may be severe, and they may even be fatal when altitude-induced pulmonary edema is present. Most symptoms decline within a few weeks, but certain effects such as an increased probability of thrombosis, and reduced work capacity, may never disappear.

Two diseases (pulmonary edema and chronic mountain sickness) are specifically attributable to the reduced oxygen levels above 2500 meters. Others such as patent ductus arteriosus, thrombosis, and any pulmonary disease that affects normal lung functioning, may be aggravated by high elevations. The late fetal development that often occurs at high altitudes may also stimulate heart defects, and any form of anemia is serious above 2500 meters (Baker 1978b:328).

Fertility and early growth are inhibited by high elevations. The main effect on the fetus is a slowing of the growth rate, especially in the last trimester. Reproductive efficiency is also impaired, since the embryo faces increased risk at the pre-implantation and early post-implantation stages. Fetal growth is slow; newborns are smaller than at lower altitudes; and there is evidence of some immaturity in the newborn's capacity to make adaptive responses. Neonatal and infantile mortality is therefore increased, and the first year's growth is retarded (Clegg 1978:106). Highlanders sometimes exhibit a slow growth in body size, delayed skeletal maturation, and a late onset of sexual maturation (Frisancho 1978:163).

Certain beneficial effects may also result from high elevations. The low temperatures, high radiation, and aridity inhibit infectious diseases, while hypoxia lowers the incidence of cardiovascular disease (Baker 1978b:330). Also, the fact that water boils at a lower temperature than at sea level may reduce the reduction or denaturation of thiamin and ascorbic acid in foods. However, it may also prevent the complete sterilization of water, resulting in increased sanitation risks (Picon - Reategui 1978:245).

There is considerable evidence that high-altitude populations have adjusted to many of these constraints through short-term acclimatizations, developmental responses, and even genetic adaptations. Certain authors, such as Cruze and Code (1978:61) and Frisancho (1978:165) have concluded that the larger chest sizes, greater respiratory capacities, and haematological characteristics of highlanders are due to development and acclimatization, and are not genetic in nature. Lowlanders who migrate to high-altitude environments sometimes develop larger chests, and increase their respiratory capacities in response to hypoxia. Highlanders also generally have superior work capacities, again due to functional adaptations associated with acclimatization (Buskirk 1978:185). They also often have two distinct physiological adaptations to cold slightly elevated basal metabolisms, and greater heat flows to their extremities (Little and Hanna 1978:290).

Other authors, in contrast, have concluded that certain populations are genetically adapted to high elevations. Quilici and Vergnes (1978:212), for example, have proposed that the haematological characteristics of certain Andean populations involves a high biological specialization that is probably irreversible. Over the generations the populations have retained those mutations most favorable to high altitudes, and the metabolic chains, especially those of the red blood cells, have adapted to a more efficient use of limited oxygen. Newcomers can acclimatize to hypoxia and insure sufficient oxygenation to their tissues, but to do so they must develop faster, more elaborate, and more expensive processes that often expose them to pathologies.

Baker (1978b:345) has suggested that several Andean haematological traits are both developmental and inherited. He also concluded that large chest size, which enhances oxygen transport, is primarily governed by inheritance. Baker proposed that there is considerable opportunity for selective pressures during the post-natal period when the effects of hypoxia are most significant. Selection apparently operates over the generations to differentiate the genetic structures of highlanders from lowlanders.

There are no Southwestern populations that reside permanently at high altitudes. There are, however, many Southwestern cultures which utilize high elevations on a seasonal and/or specialized basis, and there are small isolated towns and ranches

whose inhabitants live in the mountains on a full-time basis. Many prehistoric groups undoubtedly used the highlands in a temporary fashion, and there may even have been small, isolated permanent high-altitude populations in the past (see Benedict and Olson 1978). Whether they were permanent or short-term, it is likely that many of the biological effects of high-altitude environments that were discussed in the preceding pages affected them.

Cultural Adaptations to High Elevations

The human utilization of high altitudes involves a range of land use patterns that are as diverse as the environments they exploit. Human sites vary from isolated quarries, pastures, and other specialized locations to the large urban population centers of the Andes and Himalayas. Land use patterns vary with the environmental conditions, socioeconomic complexity, and cultural affinity. Environmental variation within a particular highland can be enormous, with major vertical gradation in a short distance. Environmental fluctuations are often great and unpredictable, so a wide range of flexible adaptive strategies have been developed by humans for survival at high altitudes. Overall there are three general patterns of resource use that have evolved to cope with the stresses of high elevations: (1) the short-term, specialized mode that most lowland cultures use; (2) the "high country adaptation" (Wright, Bender, and Reeve 1980) of certain mobile hunters and gatherers; and (3) the mixed agriculture/pastoral basis of the various permanent high-altitude populations.

Short-Term Uses

Most cultures utilize nearby highlands for specialized purposes. Land use patterns in the Southwest vary from short-term hunting, plant gathering, and mining, to seasonal grazing, tourism, and related specialized visits. Certain activies, such as geothermal development and other forms of concentrated energy extraction, may last throughout the year, but they are still specialized tasks in that small non-permanent groups utilize a narrow range of resources. Similarly, while isolated ranchers, miners, loggers, and other subgroups may live year-round in the mountains, they are dependent on the larger lowland economy for survival. "Occasional or sporadic residence in mountainous areas by subsections of a local group implies utilization of, but no adaptation to, high country procurement" (Wite, Bender, and Reeve 1980:184).

This type of land use pattern cross-cuts most, if not all of the Southwestern cultures, no matter what their socioeconomic structures. The one feature in common to all of them, whether they be Pueblo hunters and ritualists, Hispanic sheepmen, or Anglo lumbermen, is that energy subsidies have to be supplied by the lowland economy. In the case of herding, logging, and geothermal development, the activities are linked with national economies and markets, and there are often enormous energy inputs and impacts on the local ecosystem in order to exploit singular resources.

High Country Adaptation

Based on the Jackson Hole research, Wright, Bender, and Reeve (1980:195) defined this pattern as the "migration of the entire set of families through the successive elevational plateaus being exploited by the band." Specifically,

> Within each elevational level, work parties would have foraged and hunted from a local base camp. The fact of periodicity then determined the schedule of movements throughout such levels . . . The central component of the high country adaptation is identified as a shift in base camp location through altitudinal zones in response to specifically delimited periods of resource availability (Ibid:184).

Wright, Bender, and Reeve proposed that various prehistoric and historic tribes in the Jackson Hole and Yellowstone areas, and certain historic Great Basin groups, utilized this adaptation. Although it did not represent permanent, year-round occupation of the high country, the fact that all members of an entire local group, such as a band, moved up and down the elevational gradients in response to changes in resource availability set it aside from the task-specific, short-term strategy. Certain Southwestern groups, such as the Ute, Paiute, and White Mountain Apache, may have utilized the highlands in such a manner, as

perhaps did various prehistoric cultures. Benedict and Olson (1978), in fact, have proposed that the Mount Albion Complex of 6000-5500 B.P. in the Colorado Front Range represented one such high-altitude population. This hunting and gathering culture ranged from fall, winter, and spring camps in high valleys at elevations of 1800-1900 meters, to summertime game drive camps at 2380-3675 meters in elevation. Benedict and Olson suggested that the appearance of the complex "coincided with a shift in human population from dry environments in many parts of the west to regions of relatively high precipitation" (1978:167). Thus the Rocky Mountains are seen as a refuge area that received an influx of migrating cultures during a period of extreme drought. Euler, et al. (1979), have argued that certain moderately high elevations (such as Mesa Verde) were used as similar refugia in later Anasazi times.

The Permanent Use of Highlands

This strategy, which does not occur in the Southwest, involves the permanent occupation of highlands by entire biological populations and cultures that are dependent on a mixed agricultural/pastoral economy. As many as 30,000,000 people in the Andes, Ethiopia, the Himalayas, and elsewhere in mountainous and high plateau terrain follow this lifeway (Baker 1978b:317).

Despite the many cultural variations in the Andes, the Himalayas, and other permanently occupied highlands, there are a number of general adaptations that have been developed in these hostile environments. They include:

<u>High-altitude adapted crops and domesticated animals.</u> In the central Andes, maize can be grown to above 3400 meters, potatoes survive to approximately 4300 meters, and the hardy llamas and alpacas can forage well above the agricultural zones (Service 1971:337).

<u>Inter-zone economic organization.</u> One of the most signficant aspects of this pattern is a vertical ecozone arrangement, which makes a relatively large variety of resources available in a short distance. In certain pre-contact Andean cultures, group land rights in more than one zone assured access to essential resources. Now exchange among the groups in different zones and markets assure the necessary resources (Thomas, Baker, and Haas 1977: 38).

<u>Insulated domiciles and clothing.</u> Most high-altitude cultures have developed tightly constructed, draft-free structures, and insulated, multi-layered clothing that traps air (Little and Hanna 1978). The body's microclimatic temperature is thereby increased, and heat loss is reduced.

Land Use Competition and the Role of Cultural Resource Management

Perhaps the greatest challenge faced by archeologists and other anthropologists who are studying high-altitude adaptations involves the competition over the resources of highlands by a variety of cultures.

Since all of the Southwestern highlands are either privately owned or are controlled by government agencies whose policies preclude unrestricted use, disputes over grazing, logging, energy development, ritual activities, archeological excavations, and other cultural practices are inevitable. Frederick Barth's classic study of the competing interests of three highland cultures in Pakistan provides a model for analyzing the reasons and results of this competition:

> (1) The distribution of ethnic groups is controlled not by objective and fixed "natural areas" but by the distribution of the specific ecologic niches which the group, with its particular economic and political organization, is able to exploit . . .
>
> (2) Different ethnic groups will establish themselves in stable co-residence in an area if they exploit different ecologic niches, and especially if they can thus establish symbiotic economic relations . . .
>
> (3) If different ethnic groups are able to exploit the same niches fully, the militarily more powerful will normally replace the weaker . . .
>
> (4) If different ethnic groups exploit the same ecologic niches but the weaker of

> them is better able to utilize marginal environmental, the groups may co-residence in one area . . . (Barth 1956:1089).

The situation in the Southwest is more complicated than Barth's Pakistani study area, since archeological and other anthropologists are part of the special interest group that are competing over highland resources. Native Americans, cattlemen, oil companies, and land management agencies, among others, compete with archeologists over the control and use of cultural resources. In contrast to Barth, who was investigating non-western cultures in a region tens of thousands of kilometers from his home, Southwestern anthropologists are members of cultures and subgroups that are subjectively involved in the very competition they are investigating. Their research in highlands is often justified and financed by the regulations engendered by this competition, and as subjective participants of the competing groups, they often have strong economic or personal attitudes about highland areas. Thus, while the Southwestern highlands provide an ideal situation for understanding the dynamics of cultural conflict and resource competition, the subjective involvement of anthropologists in this conflict makes understanding very difficult. The separation of our personal biases from our professional "objectivity" is one of the most poorly understood and greatest challenges to the management of cultural resources at whatever elevation.

PURPOSES

This volume presents 13 papers that deal with various aspects of high-altitude resource use and management in the Southwest. Many of the papers concern specific projects, issues, or cultures, while other are regional overviews. Figure 4 shows the location of the study areas; maps of specific locations can be found in each paper.

The original version of 10 papers were presented at the School of American Research's Advanced Seminar on High-Altitude Adaptations in the Southwest; the remaining three papers were generated as a result of discussion at the seminar, or as as result of a perceived need for additional coverage.

The concept of a seminar on high-altitude adaptations was originally developed by Doug Swartz and Dee Green, primarily as a result of their awareness of the challenges confronting cultural resource management in the mountainous forests of the Southwest. They were particularly concerned with our (i.e., anthropologists) lack of understanding of the full range and meaning of high-altitude cultural resources, and our inability to properly manage them in the face of energy development and other impacts. The seminar was therefore designed with the following overall aims: (1) to define the range of high-altitude uses in the Southwest; (2) to develop a chronology of such uses; (3) to develop a series of theoretical models that begin to explain these uses and their changes; (4) to understand the problems associated with cultural resources managment in high-altitude areas; and (5) to offer a set of recommendations concerning the long-term management of high-altitude cultural resources.

The participants in the seminar and the authors of each of these papers have all been involved in one way or another with anthropological research at high elevations in the Southwest. Hopefully these papers reflect both our objective analysis of the cultural adaptations that have occurred in the mountainous regions of the Southwest, and our personal attachments to these valuable environments.

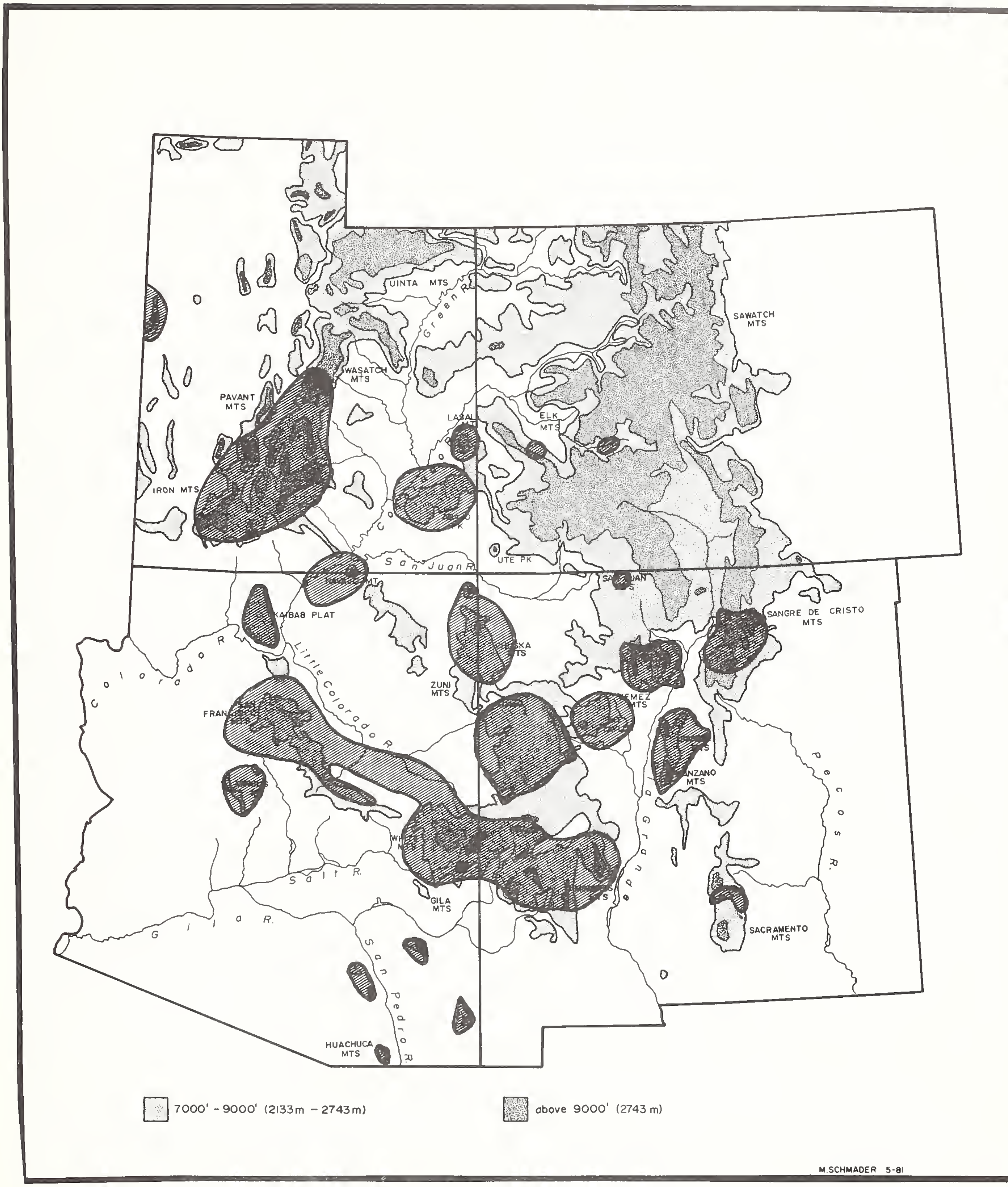

Figure 4. Location of the High-Altitude Study Areas Reported on in this Book, shown by diagonal lines.

MANAGEMENT OF HIGH-ALTITUDE CULTURAL RESOURCES

Dee F. Green

INTRODUCTION

During the past decade archeologists working in the Southwest have been discovering an increasing number of prehistoric and historic sites at altitudes above 8000 feet (2440 meters). For the prehistoric part of the record, at least some of the sites are substantial in size indicating some sort of community enterprise. Small isolated camps are still being discovered, of course, but the larger sites, some with stratigraphic depth, point up the need to examine more closely the nature of prehistoric use of high-altitude areas in the Southwest. One aspect of such examination should deal with the management of these resources.

Cultural resource management either is or is becoming the cutting edge of the discipline of archeology (Hanks 1977). Increased money available through the federal establishment for archeological work is creating extensive and intensive data bases never before available to the profession. Federally-funded surveys have produced huge site files with tens of thousands of entries. Within the next decade, such entries will reach hundreds of thousands. The management of both the sites on the ground and the information about them will be a continuing challenge.

The development of a management philosophy for cultural resources is urgently needed so that resources in all landscapes including those at high altitudes can be wisely cared for. This chapter attempts a first step toward development of such a philosophy and discusses applications of a management philosophy for high-altitude resources.

DEVELOPING A PHILOSOPHY OF CULTURAL RESOURCE MANAGEMENT

Use of the concept "cultural resource management" came into vogue during the 1970s. It is common when word strings become popular for their meaning to vary, and cultural resource management is no exception (McAllister 1977). King, Hickman, and Berg (1977:8) define cultural resource management as "Assessing the nature of cultural resources . . . ." Schiffer and Gummerman (1977:1) see it as ". . . a new social philosophy for the treatment of the all too ephemeral materials that contribute to our understanding of the cultural past . . . ." The pages of American Antiquity have, for the most part, focused on topics such as "significance" which are usually discussed in the context of law and regulation (Raab and Klinger 1977, 1979; Lynott 1980; Sharrock and Grayson 1979; Barnes, Briggs, and Neilson 1980; Klinger and Raab 1980).

Generally cultural resource management has come to mean coping with cultural resource law and the regulations issuing therefrom. Anyone who has attended the plethora of "cultural resource" seminars at annual meetings of the Society of American Archaeology over the last decade should by now be sick of hearing references to the Historic Preservation Act of 1966, Executive Order 11593, and Chapter 36, Code of Federal Regulations, Part 800 (see Matheny and Berge 1976, for one example). Too many archeologists appear to conceive of cultural resource management as complying with Advisory Council regulations and/or nominating sites to the National Register of Historic Places. Laws, regulations, nominations, their attendant paperwork, profound discussions of "significance," sorting the niceties of "effect" determinations, and such trivia are too often seen as the stuff of which cultural resource management is made. I do not agree, and I have engaged in such activities more than I would prefer over the past 10 years. In that time I have come to realize that none of the activity associated with the Advisory Council, or the National Register, and little of my activities in connection with State Historic Preservation Officers, has anything to do with cultural resource management except in the most peripheral sense.

Those who believe that promulgation of law and regulation either is or necessarily leads to resource management are sadly mistaken. Laws are important as the legal basis (authority) for doing cultural resource management. Advisory Council

procedures and National Register nominations are involved with the management of paper "resources," not cultural resources. I do not mean to imply that this is useless. I simply want the reader to understand that there is a fundamental difference between the actual dealing with cultural things themselves (management) and dealing with regulation-oriented paperwork about them (red tape). In order to manage resources, one must have some. Entities such as the Advisory Council and the National Register have pieces of paper about cultural resources and what they manage are those pieces of paper.

Resource management generally has been conducted in the United States under a variety of philosophies. Historically an exploitative ethic has dominated the thinking of Europeans from the Spanish quest for gold to modern timbering and mining enterprises. Economic growth and the acquisition of wealth at the expense of the resource is paramount. The antithesis of exploitation is the preservationist ethic which began its growth in the United States within the last century. Setting aside of National Parks (National Park Service 1964), wilderness (Hendee, Stankey, and Lucas 1978), and the Historic Preservation Movement are examples of efforts to instill resource management with a "let's keep it" philosophy. Somewhere between lies what is sometimes called the "wise-use" or conservation philosophy. Here the concept involves use of resources but in such a way that their values are either preserved or renewed.

Berry (1977) lies somewhere between the conservationists and the preservationists in espousing a philosophy of "nurture." He contrasts his position with that of the exploiters when he states that "the exploiter thinks in terms of numbers, quantities, 'hard facts;' the nurturer in terms of character, condition, quality, kind" (Ibid:8).

Between the conservationists and the exploiters lie those who espouse an economic-based management philosophy as represented by the thinking of Clawson (1974), Josephson (1976), and Walker (1977). With this group there is a realization that renewable resources need to be renewed but that the basic decision should still be made on the basis of economics, that is, greatest monetary gain. Thus there is a continuum of philosophical position with regard to resource management available for adoption within the framework of American society. A major problem facing resource managers today is sorting out how to respond to the pressures of these different philosophies, given a particular resource base with its capabilities and limitations.

Where do cultural resources fit into this picture? Until the past decade archeologists have been exploiters (Lipe 1974:214) of the cultural resource in much the same way that mining and other resource exploiters have used and abused resources. This also applies to bodies such as the Committee for the Recovery of Archaeological Remains (CRAR) which was organized to save sites from destruction (Brew 1974). Saving sites is important since they are nonrenewable but past efforts for their salvations were motivated for reasons to do with future site exploitation, such exploitation being conducted in an essentially indiscriminate fashion. It was not until after 1974 when Lipe (1974) espoused a conservation philosophy that archeologists began to think in terms other than exploitation. In fact, during the 1950s and 1960s, when the Historic Preservation Movement was blossoming, archeologists were digging in increased numbers. The bastion of preservation for archeology could have been the National Park Service whose mandate allows them to "lock up" sites and keep them for the future. Yet, the exploitative ethic continued to operate. If a site conflicted with a pet project of a park superintendent, or an archeologist with money and influence wanted to dig, the digging went ahead. At a time when wilderness preservation, historic preservation, and similar movements were changing national attitudes, archeologists continued as exploiters. As one who lived through these times as both a student and young professional, I remember there was always concern for what others did to sites, but no concern beyond our field techniques about what archeologists were doing to the resource base.

What archeologists shared with the preservation movement of the 1960s was a desire to preserve artifacts but not necessarily sites. Under the theory that an archeologist can dig a site in such a way that he preserves all information and can take it back to the lab, there was little need to think of site preservation for any other

reason than that an archeologist could later dig it. Preservation of artifacts, provenience, notes, photos, and other documentation was seen as sufficient preservation with little need to keep sites intact on the landscape.

Other forces began to move the archeological community during the 1960s. These contributed to the emergence of the conservation ethic that occurred in the 1970s. Rise of the so-called "new archeology" during the 1960s has generated much discussion about "how new is new." Nevertheless, it seems to me that an important contribution of the 1960s was the introduction of the notion that excavation of a site destroys data, regardless of how much care is taken with an excavation. With the theoretical and philosophical impetus of Binford and his students, contributions to this notion were made by the increased sophistication with which physical analytical techniques were applied to sites. At the same time, the introduction of computer assisted research opened increasingly sophisticated approaches to data manipulation (Gaines and Gaines 1980). Computer use necessitates a more sophisticated gathering of data for some problems. It has opened the door to the reanalysis of materials excavated in the past (Green 1974), thus extending the life of certain data bases and, in some cases, obviating the need for additional excavation.

As archeologists began to swing from exploiters to conservationists during the 1970s, the influence of the historic preservationists was also being felt. It was most evident in the regulations emanating from the Advisory Council and the National Register. These are written from a decided "preservationist" philosophy resulting in a great deal of discomfiture between archeologists and historic preservationists. The situation is reflected in events such as the Ft. Bergwin conference on significance, the Advisory Council's Issues in Archeology report (1977), the Arlie House Seminars (McGimsey and Davis 1977), and interminable discussions and arguments about "significance" wherever archeologists gathered.

By the mid-1970s a few of us began to realize that the fear of losing the nation's prehistoric resources was on the way to becoming a self-fulfilling prophecy. It was realized that archeologists themselves (not just government agencies) were major contributors to that condition. The time had come for somebody to say to an archeologist, "No, you may not dig that site no matter how important it is to you personally." Someone had to begin making decisions about how and when the prehistoric resource would be used. The decision should not be made on the basis of excavate whenever a site is threatened with damage or destruction, or "Gee, isn't that a neat site, let's go dig." In other words, the time for managing the resource had arrived. As the decade closed, conservation oriented management increased due principally to the exposure of an increasing number of archeologists to resource-oriented land managing agencies (Dickens and Hill 1978). Some archeologists were told that they could not dig a site that was dear to their hearts and it was made to stick. Others went to court in an effort to force an agency to consider a cultural resource on its actual merits rather than digging because the site was in the way. Such events will occur with greater frequency in the future as more archeologists are willing to say "no" to cultural resource exploiters whether agency, industry, or individual.

CONSERVATION MANAGEMENT FOR CULTURAL RESOURCES

Propounding a philosophy of conservation management for cultural resources is one thing, implementing it is another. Walka (1979) has defined management as "planning, organizing, directing, and controlling resources toward the achievement of an objective." The objective is conserving (making the wisest use) of our nation's cultural heritage. That heritage includes prehistoric and historic resources as well as living resources. However, I've drawn my examples and discussion from the prehistoric record. Each of the four principles of management listed by Walka may be applied to cultural resources.

Planning

Planning involves setting out a detailed course of action designed to achieve a given result (Ibid:567). In planning, an inventory of resources must be available which finds them in space and characterizes their nature. In the past, inventories have been available through State archeologists and/or universities. The inventories, however, have seldom contained enough

information to be of much value in planning even if archeologists had been interested in using them that way. During the last decade federal land managing agencies have begun developing site inventories on a more systematic basis although there are still large gaps in coverage, some of which may not be filled for another 10 to 20 years.

Despite the knowledge gaps, agencies such as the Bureau of Land Management and the Forest Service are mandated to complete long range land management planning. In the Forest Service, at least, cultural resources are integrated into the planning process and must be addressed in Forest plans. Generally, the planning process involves two steps. First, information is gathered about the resource base. For cultural resources, this is usually taken from site files, archeological/ethnographic literature, and personal knowledge of scholars working or who have worked in the area. In some cases this information is formalized into "overviews" of the kind jointly published by the Bureau of Land Management and Forest Service (Cordell 1979; Berman 1979; Tainter and Gillio 1980; Plog 1981b), developed by a single agency (Brooks, Brooks, and King 1977; Jermann and Mason 1976; Lalande 1977), or background documents of the kind prepared by Plog (1981a). In other cases, information may be used as direct input into the second step.

The second step in planning involves either integrating the cultural resource into an overall resource plan or developing a plan for cultural resources only. Generally speaking, the latter has not been done except in a few cases by the National Park Service. Claims that the National Register is a cultural resource planning document are not reasonable. It is simply an inventory of some of the nation's better cultural resources. Even as an inventory its usefulness is limited due to the vast number of resources which are not listed and which may never be listed.

To have value as a planning document, decisions must be made which allocate and group the resource base. That is, decisions must be made about <u>how</u> and <u>when</u> the resource base will be used. For example, this might involve decisions to allocate portions of the resource for public interpretation, scientific investigation, or long-term preservation. When, refers to the timetable of use. Some site might be allocated for scientific use in either the immediate or distant future. Some uses such as public interpretation are compatible with scientific use although interpretive needs might serve to emphasize some research questions and eliminate others. Given the inventory gaps referred to earlier, some management plans in current development cycles are including planning for inventory completion. This involves establishing inventory priorities.

Until that is done, managers must struggle with the problems of resource allocation based on current data. This situation often is not as difficult as it may seem. The Apache-Sitgreaves National Forests have a statistically sound one percent sample of all National Forest lands above the Mogollon Rim (Donaldson 1975; Plog 1981). Other federal lands have samples which may be used with differing degrees of confidence. Professional judgment must be relied upon in still other cases. Allocation of resources in a plan should be constrained by the kind and reliability of information available. Archeological advice is important in this process.

Grouping of the resource refers to the geographical extent of the planning unit, not to groupings inherent in the resources themselves, such as time period or cultural affiliation. Planning unit boundaries usually are dictated to the archeological profession because they are tied to other planning undertaken by agencies. This need not be the case except that archeologists generally are not involved in resource planning in any other context. This is not an unworkable situation, but it takes some adjustment in thinking, and one is not always able to deal with units which make archeological sense. Nevertheless, important opportunities can be created with government support, as this book illustrates. Its publication should have important consequences for those agencies (principally the Forest Service and Bureau of Indian Affairs) who deal with high altitude land surfaces and the cultural resources in and on those surfaces. Archeological expertise is being brought to bear on the nature of such resources and recommendations for allocating cultural resources could be an important contribution of this conference.

Organizing

Walka (1979:577) defines organizing as, ". . . establishing a system of relationships among people and functions." He notes that there are three relationships involved: 1) authority, 2) responsibility, and 3) accountability. There is no overall organizing entity in cultural resources management nor, in my opinion, should there be. I am aware of opinions by various individuals that Interagency Archaeological Services or the Advisory Council should fill such an overall organizing role. I disagree. My experience suggests that any entity trying to set itself up as the cultural resource management agency would fail because it would not possess the resources themselves. Possession not regulation or red tape is the key to management. Furthermore, a single management agency would soon be managing by some inflexible rote technique designed to resist change. Good and wise resource management must be flexible and willing to innovate as the nature of the resource base changes and improved management techniques are invented and applied.

Regardless of one's position with regard to single or multiple organizational structures, the reality is now that multiple structures do exist and must be recognized. The single biggest weakness evident among contract archeologists is a failure to understand and cope with organizational differences in state and federal agencies, and differences in how cultural resource programs are organized from agency to agency (Rock 1977; Klein 1977; and Advisory Council 1977). Most nonagency archeologists probably understand that there are agency differences but often this does not get translated into how and why management programs are different or, in some cases, absent.

Another evident problem is the failure to appreciate where agency archeologists stand within an organization in terms of their authority, responsibility, and accountability toward cultural resources. An archeologist attached to an environmental unit whose job is to deal with the National Environmental Policy Act and/or Section 106 compliance has very different responsibilities and influence than an archeologist attached directly to a land manager who is daily or weekly deciding what will happen to resources. Compliance is not management, so many archeologists working in the federal sector do not work as archeologists. They work as compliance officers. That they know something of archeology is often useful, but not necessarily mandatory in the job they perform. In some cases, a competent technician could handle the job, especially when archeological matters are left to State Historic Preservation Officers or abdicated to contractors (Green 1980). Organizationally then, as well as philosophically, it helps to distinguish between management and compliance. Not all federal or state agencies have cultural resource <u>management</u> programs, even though they are sometimes called that.

Walka's (1979) criteria of authority, responsibility, and accountability are excellent yardsticks for measuring whether or not a program is really doing cultural resource <u>management</u>. Authority is the less diagnostic measure since there are agencies which have authority and do not use it. There are agencies which delegate authority to other entities. Sometimes this is done formally, as when an agency would let the former Heritage Conservation and Recreation Service exercise agency prerogatives. Compliance oriented agencies will sometimes abdicate to the State Historic Preservation Officer and the Advisory Council not only authority but responsibility as well.

Assumption of responsibility for cultural resources by an agency is usually dependent on acceptance by agency personnel of the notion that cultural things are resources worth managing. Once that is hurdled, regular responsibility within the organizational framework is divided. In the Forest Service, archeologists do not have direct decisionmaking responsibility. They do not decide how and when to allocate a resource. Their responsibility is to advise the decisionmaker and <u>suggest</u> how and when the resource should be allocated. If the advice is sound, well reasoned, and presented in such a way that the manager clearly understands the alternatives and consequences of the decision, he will seldom decide on a course that is detrimental to a cultural resource. The ability of archeologists to influence decisionmaking is directly related to the professional approach taken in dealing with a decisionmaker. Reasons why the resource is important and why a site is important will more often positively influence a decisionmaker than statements about obedience

to law and regulation.

Accountability is the weakest and least used of organizing principles. The decisionmaker usually is most accountable and is the easiest person to hold accountable. One can measure the number of cultural resources saved or destroyed. What is difficult to implement is accountability on the part of the adviser, that is, the archeologist.

Within the Forest Service, archeologists are required to write and sign clearance reports on projects which gives some measure of accountability. It is difficult to measure the large amounts of verbal advice that is continually given. Job performance ratings may or may not deal with factors relating to wise management of the resource. Finally, how does one judge the performance of the advisor if the manager makes a decision that is not in the best interest of the cultural resource? Accountability is one area within the organizing of cultural resource management that needs attention.

Directing

This is the third organizing principle which Walka (Ibid:577) defines as ". . . the process of stimulating action within the organization." In cultural resource management, my general impression is that stimulating is not a problem with archeologists. They are usually motivated and industrious although sometimes misguided. The real problem is with the decisionmakers in the management community. Action by nonarcheologists is not necessarily perverse, although such cases do occur. Usually ignorance of the resource and/or of how to manage it results in inaction. Awareness training and other educational mechanisms are sometimes effective, although in perverse cases legal action may be necessary.

Directing is related to organizational structure and how authority mechanisms are implemented. In the Department of Interior, decisionmaking tends to flow upward in the organizational structure with more decisions made at higher levels. In the Forest Service, the flow is downward, with more decisions made closer to the operational base from which the resources are managed. My preference is for decisionmaking at ground level, especially if archeological expertise is available. The further the decision is removed from the resource, the more likely a decision about the resource will be made on political or other grounds extraneous to the resource. Such decisions are less likely to consider what is in the best interest of the cultural resource. This is not to suggest that there is no need for "big picture" decisionmaking. However, its role should be controlled. Where real management is practiced, problems are not as acute as where compliance is the operational philosophy, since compliance operates in a short-term, nonplanning framework.

Controlling

This final management principle is defined by Walka (Ibid:578) as ". . . the process of comparing organizational activity with organizational plans and goals." To me, there is little or no application of this principle in cultural resource management. Steps in this direction should and, in some cases, are being taken but movement appears to be slow (Skinner 1977). Again, using the Forest Service as an example, "monitoring" is required of resources under the provisions of the land management planning mechanism. This will not occur, for cultural resources at least, for several years and no data will be available for comparison until sometime during the first 5-year planning cycle which will be completed in 1985. The Forest Service conducts activity and management reviews, which is a controlling function, but to date only a few have included cultural resources.

I do not know about this activity in other agencies within the Federal Government and I suspect even less is being done at the State level.

In summary, cultural resource management involves the planning, organizing, directing, and controlling of the resource base in order to wisely use those resources under a conservation philosophy. Cultural resource management is not following compliance procedures or nominating sites to the National Register, although these activities are a part of the overall management process. The most serious problem facing cultural resource management today is the failure to perceive management as something other than compliance. Were the energy we spend on compliance redirected to

management of the resource, the goal of conserving cultural things would be much better met and the necessity for "compliance" activity greatly reduced.

HIGH-ALTITUDE CULTURAL RESOURCE MANAGEMENT

High-altitude settings increase the complexity of resource management. For example, diversity of plant resources, terrain, and outdoor experience opportunities require more complex management prescriptions. In addition the following are some of the areas that must be considered: watershed, livestock grazing, wildlife needs such as elk calving, fragile soils, heavy understory, and fuel loading. Heavy precipitation will normally prevent serious fires but it may, along with steep slopes, contribute to soil erosion. On the other hand, dry years can result in fire where devastation increases due to the higher fuel loadings at high altitudes. Livestock grazing must be managed so that habitat for wildlife is not depleted. Care needs to operations so that snags are left for cavity dwelling birds and as perches for raptors, escape routes are provided for big game, and roost or nest trees are maintained for turkey and squirrel. Access for fire, recreation, and other management needs adds to the complexity due to the varied terrain and steep slopes. Some ecotypes such as alpine meadows are in short supply in states like Arizona. While most of these concerns exist at lower elevations, the overall situation is more complex at higher altitudes.

Cultural resources form a part of this overall complexity and have special considerations of their own. Site visibility is a major consideration in doing inventory, so an archeologist should at least be aware that high altitudes could have had many ceremonial and even extractive use areas for which there would be no archeological record.

One of the more interesting questions raised by the discovery of large high altitude sites is the question of group size at such sites. Assuming seasonal occupation any or all of the following conditions could obtain: (1) small groups reoccupying a site for many years; (2) large groups reoccupying a site for a few years; or (3) single event occupation. Given the concentrated populations in the Southwest during some time periods (Pueblo III-Pueblo V), it is not inconceivable that some hundreds of individuals from villages with populations of 1000 or more could have moved to nondispersed summer living abodes at higher elevations. In fact such a pattern could well have been highly adaptive for larger villages. By hunting, gathering, and storing high altitude food resources, an additional margin of food for winter use could have been procured. Villages large enough to provide personnel for both farming and high-altitude procurement would have an advantage, expecially in years when crops were less plentiful.

Understanding small sites continues to be important both in terms of food procurement, lithic, and other tool resources. Nor can ceremonial uses be overlooked. Trade and travel routes no doubt existed and use by hunters-gatherers as well as agriculturalists is important. Historic sites, both Native American and Euro-American, also occur and deserve a place in any management scheme.

A general characterization of high altitude cultural resources might include: (1) low site density compared to lower elevations, (2) higher relative density of extractive sites such as lithic procurement stations, (3) higher ratio of small sites to larger sites compared to lower elevations, (4) very low incidence of site occurrence on north exposures and steep (above 40 percent) slopes, (5) time periods from Archaic through Historic represented, (6) summer dominant seasonal use, (7) hunting and gathering food resource extraction with no agriculture, (8) specialized ceremonial sites, and (9) relatively few permanent structures compared to lower elevations, with ceremonial structures the possible exception.

Good inventory data remains a problem in some areas but more and better data are available than ever before. They are increasing yearly. Some high altitude excavation has been done, but there is generally a dearth of excavation-derived information for making interpretations. High altitude environmental information is available but is largely uncompiled and unknown within the archeological community. Given these assumptions about the nature and condition of the resource, some management implications for cultural resources will be discussed.

In planning for the wise use of high-altitude sites, there is a continuing need for inventory. Much of the high-altitude country exceeds the 40 percent slope limitation and/or involves north facing slopes. Cave surfaces for rock art, or lands near springs are exceptions. These areas, along with land surfaces below 40 percent slope, could be stratified for complete coverage while the remainder might be sampled at a very low fraction, say .01 percent, and with a low priority. The following considerations should be kept in mind when making allocation decisions. Selection of sites for long-term preservation should be influenced by wilderness designation (Green 1979). Since wildernesses are set aside to preserve the land in its pristine condition and little surface disturbance is allowed, there is less chance for resource conflicts that might require a site be excavated. Sites outside wilderness probably will be selected for long-term preservation but wilderness sites, as a group, also might fall in that category. Sites selected for public interpretation generally should be at or near already developed facilities and travelways. Interpretive stations need not be elaborate since only seasonal use can be expected. Exhibits or other facilities should be either easily removed and reinstalled, or able to withstand winter conditions.

Scientific use of high-altitude resources should be highly controlled. There is a need for excavation at a few specially selected sites. One should be a large site with structures but the site should be sampled rather than completely excavated. All scientific work needs to be done under well conceived research design(s). This book could help formulate the outline of a design and suggest the important questions which need to be addressed. Talk about Regional or State-wide research designs have borne little fruit outside the Southwest (Grady 1976, 1977; Stuart and Gauthier 1981). However, it may be worth exploring this possibility with the high altitude country of Arizona and/or New Mexico. Sites which are in current use by Native Americans should be left alone. It has been suggested that such sites be nominated to the National Register. Below I will discuss why I do not believe this is the right thing to do.

COORDINATION WITH OTHER RESOURCES

Natural resources are managed on high-altitude lands throughout the Southwest. Other resource uses include recreation, wilderness, timber, grazing, wildlife, soils, and minerals. As a general rule, cultural resources can be managed in harmony with these. Logging, campgrounds, shaft mines, and range improvements, for example, can usually avoid cultural sites. Maintaining wildlife habitat and ground cover and preventing soil erosion usually protect sites. There are some activities associated with these resources which could damage or destroy cultural values. When this occurs, trade-offs must be made.

Deciding whether the cultural resource should be removed or a project discontinued may be very straightforward. If an open pit mine is involved, unless the cultural site can be shown to have extremely high value for <u>in situ</u> preservation, removal should probably occur. Even when <u>in situ</u> preservation is preferred it may or may not be legally or politically prudent to contest the mining rights. Engineering a timber road through an area that contains a very important site can be complicated. Costs, revenue loss, information loss, and other factors will need to be considered. This may seem little different from lower altitude management. However, at high altitudes generally, the factor of more abundant, steeper slopes affects both the cultural resource locations as well as those of other facilities. With less ground available for some kinds of facilities there is more apt to be conflict as current needs compete with prehistoric sites for the same limited acreage.

MANAGING NATIVE AMERICAN USE OF HIGH-ALTITUDE SITES

Native Americans use high-altitude locations for extractive and ceremonial purposes. Extractive uses such as plant gathering are essentially for personal or ceremonial use and are not regulated. Hunting, however, is a problem since some ceremonial occasions require the taking of deer. While the Forest Service administers the land, game is managed by the state and they must issue any permits for hunting out of season. Mineral removal such as obsidian, pigment, or clay could be for

commercial use but the quantities are very low. I know of no effort to control such use when done by Native Americans. As a general rule, Native Americans are allowed to extract resources for personal or ceremonial use without cost and usually without permits.

Group or individual ceremonial activities normally are allowed without special consideration. In the past, there have been attempts to get the Forest Service to adopt more formal management policies toward ceremonial sites. In one case, the Forest Service was asked to nominate 8000 acres surrounding Chicoma Peak to the National Register. My inspection of the site on top of the peak and some surrounding areas left little doubt that the site on the peak itself met National Register criteria. There was no evidence to support the 8000 acres. Nomination of any part of the area to the Register and invoking compliance procedures would create critical problems with current use. Allowing ceremonial activity on the site would be an undertaking, necessitating a determination of effect. In order to determine what effect the current ceremonial activity would have on the site it would be necessary for the Indians to reveal what they do there. Assuming that the manager was willing to ask and the Indians were willing to tell, it would then be necessary to decide if the activity created an effect on the site. If the site were to be affected in such a way that its National Register qualities were harmed then a mitigation plan would be prepared. It is not inconceivable that such a plan could ask the Indians to change their ceremonial behavior. Obviously, compliance opens up situations which are both intolerable and unnecessary.

Nominating a currently-in-use ceremonial site will give no advantage to the Indians. The site would be publicized and National Register status does not allow exclusive use by the Indians. It would appear that there are no good reasons for attempting to interfere with Indian ceremonials. The hands-off policy which has been adopted by the Forest Service in the Chicoma Peak case is best. Nothing will be gained by nomination and raising compliance issues. The State Historic Preservation Officer has agreed and the site has been placed very low on the priority list of things to accomplish under the cultural resource management program. Other problems, however, are not so easy of solution.

Sometimes an agency finds itself caught between conflicting uses which are not necessarily central to its mission. San Francisco Peaks is such a case. A concessionaire wants to expand skiing facilities. Both Navajo and Hopi hold the Peaks sacred; they object to expansion and some want all current facilities removed. A decision by the Regional Forester to allow no expansion but to continue present occupancy was appealed to the Chief of the Forest Service by both sides and ended in court.

Bureau of Indian Affairs dealings with cultural resources have a constraint different from the Forest Service.

Resources on Indian lands are administered by the BIA under the fiduciary responsibility of the Secretary of the Interior but the lands themselves are held by the Indians. Contemporary Native American groups are free to manage cultural resources on their lands where federal funding is not involved. Some groups such as the Zuni and Navajo have their own cultural resource programs, others do not.

Management and the Native American is a far more complex problem than dealing with prehistoric resources since the people are alive and capable of action (Harding 1978). Social anthropologists have not become involved with the Native American-cultural resource-agency triangle to any great extent. This is a complex field of endeavor and awaits study and solution. Perhaps it will take more conflict situations such as the San Francisco Peaks to get agencies and social anthropology communicating. The decade of the 1980s will herald the beginning of involvement of social anthropologists in the cultural resource enterprise (Jacobs 1978) just as the 1970s involved the archeologists.

SUMMARY

This chapter has elaborated on several points. First, the philosophy currently in vogue among cultural resource specialists is that of wise use or conservation of the resource despite a history of exploitation by the archeological profession. Second, compliance and National Register nomination are not management nor can they be. Cultural resources are located on or in the

ground or in museums, and are not pieces of paper in file cabinets. Third, management consists of at least four processes: planning, organizing, directing, and controlling. Most of these processes are in their infancy in cultural resource management. Fourth, high-altitude cultural resources and their management are characterized by several factors, which include seasonal use, high proportion of steep-sloped country, comparatively lower site densities per square mile, and higher incidence of prehistoric and modern use of identical space on the landscape. Fifth, despite potential conflicts, cultural resource allocation can occur so that sites may be saved for the future, used by the scientific community, and interpreted to the general public. Finally, use by modern Native Americans is of concern to management and will need innovative and informed approaches as social anthropologists become involved in the 1980s.

Cultural resource management is a developing, dynamic, and exciting field. High-altitude concerns are an important area of endeavor for researchers and managers. Because the majority of high altitude lands in Arizona and New Mexico are under the jurisdiction of two agencies, there is greater potential for interfacing research and management. Hopefully, this book has contributed ideas to nurture that interface. Such efforts discharge our responsibilities to our past and leave a better heritage for the future.

PART TWO: HIGH-ALTITUDE CULTURAL RESOURCES IN ARIZONA

HIGH-ALTITUDE BIOTIC RESOURCES, PALEOENVIRONMENTS, AND DEMOGRAPHIC PATTERNS: SOUTHERN COLORADO PLATEAUS, A.D. 500-1400

Richard H. Hevly

INTRODUCTION

Ecosystems are functional units of nature each composed of a biotic community that is interacting with its biotic and abiotic environment. A biotic community owes its existence in time and space to the overlapping genetically determined tolerance limits for various biotic and abiotic factors of the species comprising that community. As biotic and abiotic factors change in time and space, species will respond individualistically and hence the composition of biotic communities changes through both time and space (Whittaker 1975). While biota integrate their inter- and intra-specific relationships, edaphic mosaics, and climatic gradients, the significance of individual abiotic and biotic factors changes through time but nevertheless results in general zonal distributions (Figures 5-6).

Man, like all other animals, is closely tied to the biotic resources which he uses as food. Such resources, as is man, are distributed in space according to their genetically determined tolerance limits for various biotic and abiotic environmental factors. On the Colorado Plateau, populations of prehistoric agriculturalists apparently underwent episodic changes of density, at least locally, and also changed their distribution through time and space. Such changes could reflect the response of human populations to altered carrying capacity of biotic resources as influenced by environmental change, including human technological effects (Euler et al., 1979; Hevly, Halbert, and Jeffers 1980). Comparison of biotic resource distributions with prehistoric demographic patterns, paleoecology, and agricultural adaptations may permit elucidation of underlying cause(s) of specific demographic trends.

ECOSYSTEMS OF THE COLORADO PLATEAUS

Abiotic Characteristics

The Colorado Plateaus are largely composed of Paleozoic and Mesozoic sedimentary rocks, although igenous rocks are commonly encountered above 2250m (Table 1). Cenozoic tectonism, volcanism, and erosion have resulted in more than 4000m of vertical relief and associated climatic variation as well as extremely rugged terrain with diverse land forms and rock types. Despite the general aridity of the American Southwest, permanent sources of water are present and have carved deep canyons. The sediments transported from the relatively more elevated portions of the plateaus have accumulated in numerous small basins or parks and flood plains of the drainages. Soil formation, resulting from the interaction of plants and climate with these diverse parent materials, has proceeded slowly under the sparse vegetation and harsh climates of the plateaus, yielding poorly developed, thin soils in all but those limited sediment accumulating areas. Soils suitable for agriculture are therefore of restricted occurrence, variable quality (often requiring careful husbandry and fertilization), and slow to rehabilitate following disturbance (Berlin et al., 1977; Eyre 1963).

Table 1 shows the chemical and physical characteristics of some represenative soils from the southern Colorado Pleateaus. In addition to noting the general trends of variability, perhaps the most significant information to be derived from the data are inferences regarding the water holding capacity of such soils and their ability to sustain plant life in periods of drought. Clay rich soils have the highest water holding capacity and lowest permeability while coarse textured soils are the reverse. A 4-5 inch (7.5-10 cm) summer rain may only saturate the upper foot (30 cm) of a clay rich soil while it may percolate to a depth of several feet in a coarse textured soil. Since water loss by evaporation is largely restricted to the upper foot of soil, the clay soil may be depleted of available soil moisture long before the coarse particle soil, unless the clay soil has been previously saturated to

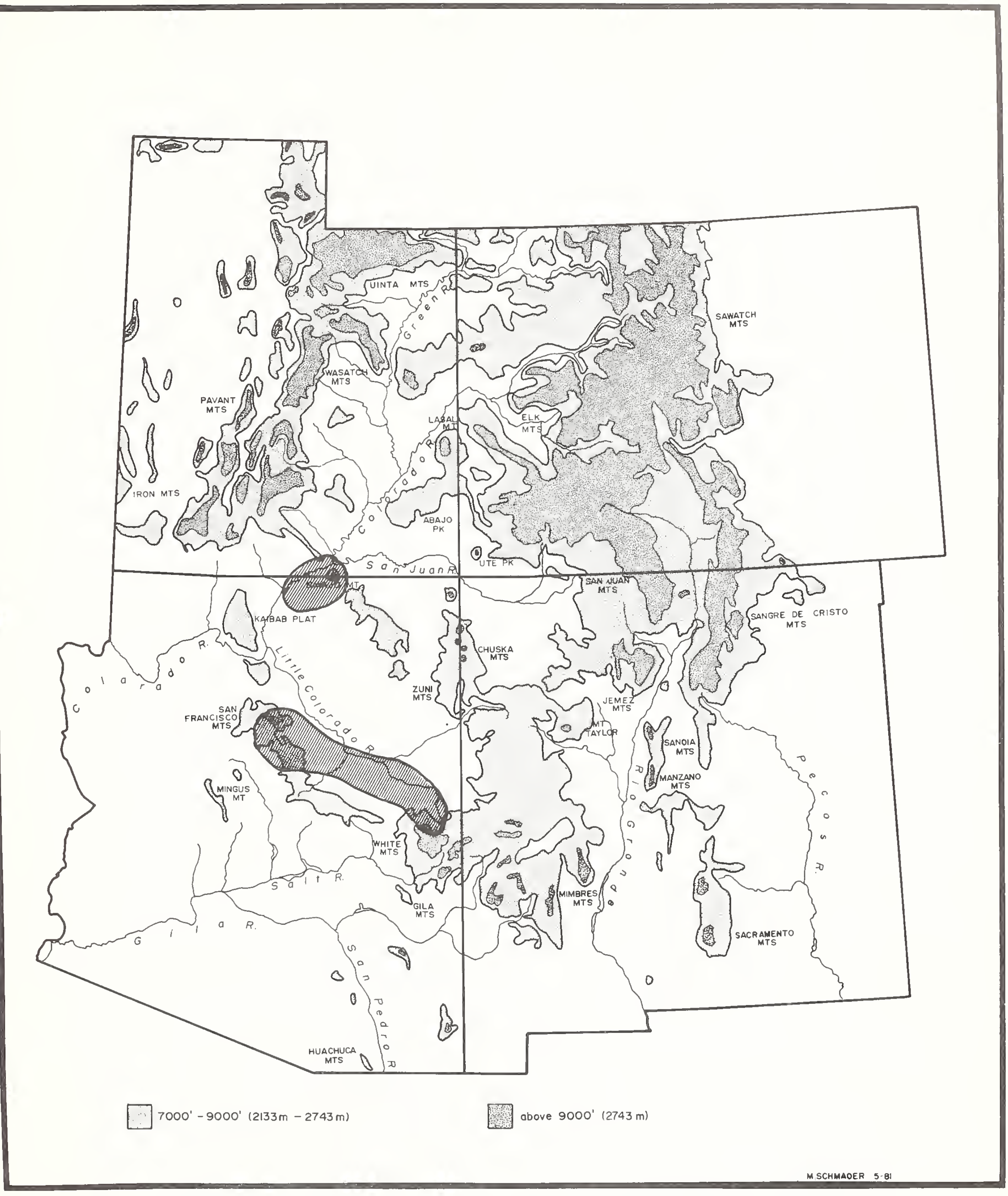

Figure 5. Location of Southern Colorado Plateau Study Area, shown by diagonal lines.

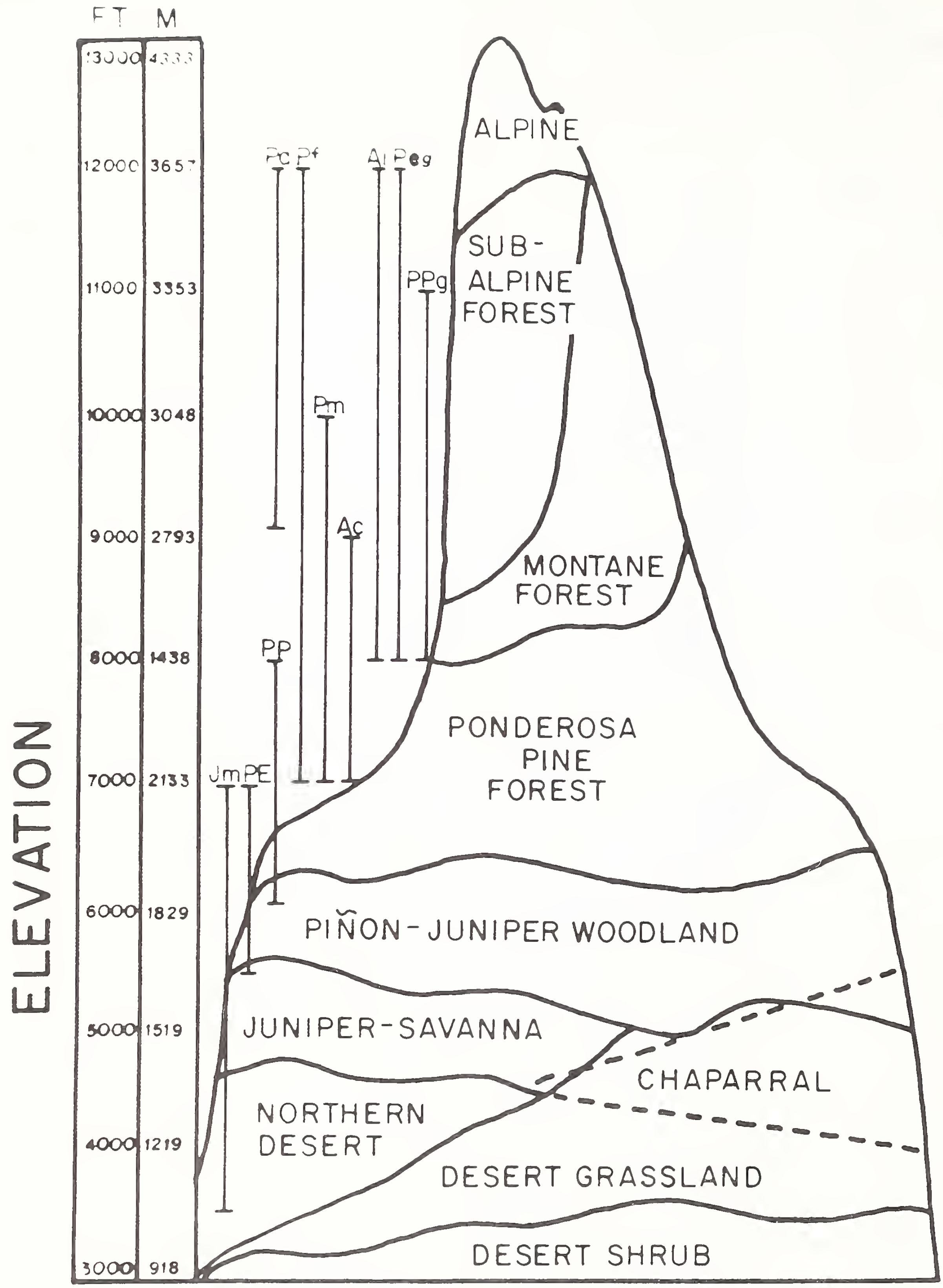

Figure 6. Generalized Zonation of Vegetation as Might be Observed on the Southern Portion of the Colorado Plateau.

Table 1. Representative Soils of the Southern Colorado Plateaus (from Pearson 1931)[1]

Vegetation Type	Soil Origin	Altitude (meters)	Mechanical Analysis(%)[2] Gravel	Sand	Silt	Clay	pH[3]	Chemical Analysis(%)[2] CaO	K_2O	P_2O_3	N
Krumholtz	volcanic (acidic)	3,507	43.5	25.7	21.7	9.0	6.5	5.65	2.02	0.30	0.32
			3.8	43.5	38.1	14.5		4.16	2.01	0.25	0.18
Engelmann Spruce Forest	volcanic (acidic)	3,202	6.6	30.8	38.8	13.4	6.5	3.81	3.16	0.15	0.26
			21.0	33.8	33.9	12.0		4.34	1.89	0.13	0.09
Douglas Fir Forest	volcanic (acidic)	2,653	6.0	35.0	44.1	14.6	6.8	4.77	2.09	0.12	0.33
			8.6	35.5	40.2	15.6		4.43	1.79	0.16	0.20
Yellow Pine Forest	basalt	2,226	3.1	36.7	45.9	14.2	7.0	2.76	2.05	0.21	0.11
			1.3	31.3	41.6	25.9		1.98	2.01	0.24	0.11
Yellow Pine Forest	limestone	1,982	4.0	50.8	36.5	8.6	---	2.39	1.93	0.13	0.11
			2.2	78.7	14.2	5.8		0.87	0.96	0.12	0.04
Pinyon-Juniper Woodland	limestone	1,982	---	----	----	---	8.0	----	----	----	----
Grassland	limestone	1,525	---	----	----	---	8.0	----	----	----	----

[1] Pearson (1931) has noted that with increase in altitude there is an increase of humus until a maximum thickness of humus and intensity of humus color are reached in an altitudinal belt ranging from 1,830 m to 3,050 m following which there is again a decrease to the top of the San Francisco peaks. Relatively high water-holding capacity and wilting coefficient are favorable if they are the result of humus rather than clay content, because although humus may withhold water to a considerable extent, it increases permeability and fertility. Pearson (1931) has further noted that in the San Francisco Mountain region both desert-grassland and alpine soils may be characterized by high content of coarse particles and low content of clay (= low water holding capacity) while between these two extremes the soils contain a high percentage of clays and a higher water holding capacity.

[2] Data on mechanical analysis and chemical analysis given for two depths: 0-5 and 30 cm.

[3] pH measurements were determined on soil at a depth of 15 cm.

a greater depth, for example, by winter rain. Thus, the effects of drought are first apparent on clay soils, due to their low permeability to both water and roots (Pearson 1931). Soils dominated by coarse particles may be devoid of moisture in the upper foot yet provide a more favorable habitat for plant life than clay soils provided seeds are able to germinate and roots are able to penetrate to adequate depth. It is not surprising then that annual summer crops are often planted in sandy soils. However, drought episodes of sufficient magnitude and duration could stimulate dry land farmers to utilize or move to more water favorable habitats or create them by irrigation.

Climatic factos vary with elevation, becoming progressively less suitable for agriculture with increasing elevation (Figure 7). As expected, temperatures decrease with increasing elevation, with diurnal temperature extremes often differing by 35 to 45°F. The frost-free periods range from nearly 300 days at 4000 (1200 m) to 8000 feet (2400 m) (Figure 8). As expected, precipitation increases with increasing elevation, occurring in two principal periods, winter and summer, which alternate with quite dry intervals. Winter precipitation is widespread and gentle, and it generally percolates into the soil better than moisture from summer storms which are torrential and occur locally. Winter precipitation often does not become available at higher elevations until spring temperatures increase enough to thaw the soil. Summer precipitation, particularly at lower elevations, flows over the surface of the land due to its torrential delivery, the relatively low vegetation cover, and the organic content of soils which might otherwise impede its run-off and enhance its percolation.

How much water is delivered to the soil is not nearly so significant as how much the plants are able to recover and retain. Atmospheric conditions of the Southwest favor extremely high water loss both from leaf and soil surfaces. Wind and high temperature enhance evapo-transpiration while humidity decreases it. Both wind movement and relative humidity increase with elevation but are greatly influenced by canopy cover and exposure (Pearson 1931). Another abiotic factor affecting plant distribution is fire which increases in frequency with elevation due to lightning. While frequency of fires has probably remained relatively constant, the nature and effects of fire have not, due to fire control practices. Fuels accumulate on the forest floor within protected forests and lead to highly destructive widespread fires that were uncommon in prehistoric time. Forests are now more frequently destroyed rather than simply having the grass and underbrush burned off to ground level.

Finally, it should be noted that intensity of radiation increases with elevation while concentration of gasses within the atmosphere become less. These latter factors in combination with biotic factors to be discussed below are probably of greater significance to animals than to plants, particularly at very high elevations.

Biotic Characteristics

Despite the climatic and edaphic limitations found on the southern portion of the Colorado Plateaus, the existing multitude of micro-habitats have come to be occupied by a diverse flora and fauna numbering in the thousands of species which are distributed relative to their tolerance of various abiotic and biotic factors. The temperature-moisture gradients occurring on the Colorado Plateaus result in a characteristic zonation of vegetation types (Figure 6). Community types range from deserts and grasslands to coniferous forests and alpine tundra, the historical development of which is undoubtedly related to climatic change and geological events of the preceding eons (Nations et al., 1981).

Plan distributions are primarily controlled by abiotic factors; the upper altitudinal limits are largely controlled by low temperatures while the lower altitudinal limits are largely controlled by deficiencies of effective moisture (Pearson 1931). Plant distribution is, of course, also affected by biotic factors, such as inter- and intra-specific competition for environmental resources, disease, and herbivors.

Animal distributions are primarily controlled by biotic factors, such as the availability of suitable food, inter- and intra-specific competition for environmental resources, shelter, disease, and predation. Such factors are frequently

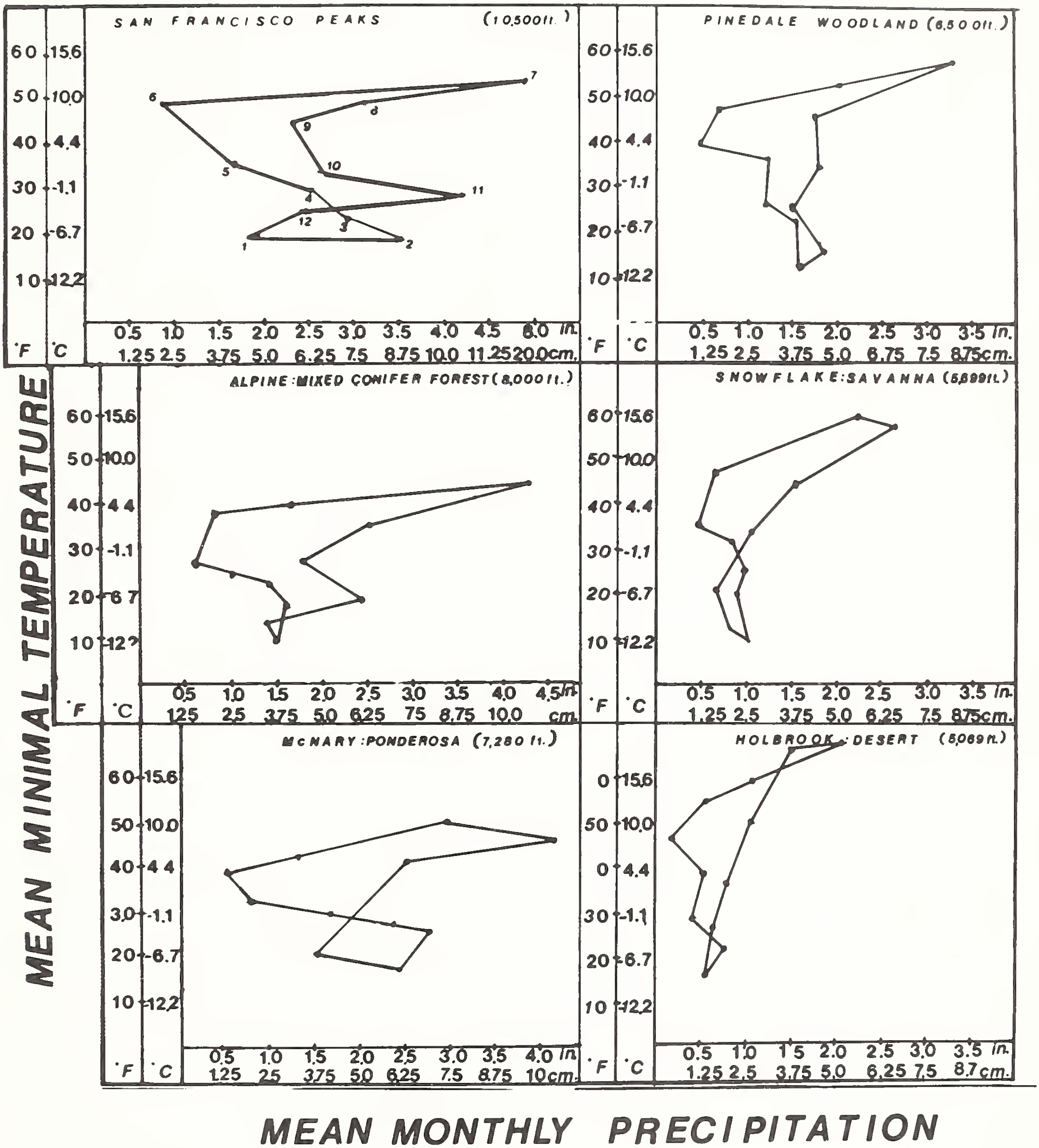

Figure 7. Climcgraphs at Different Elevations with Different Climatic Types and Plant Communities from Northern Arizona.

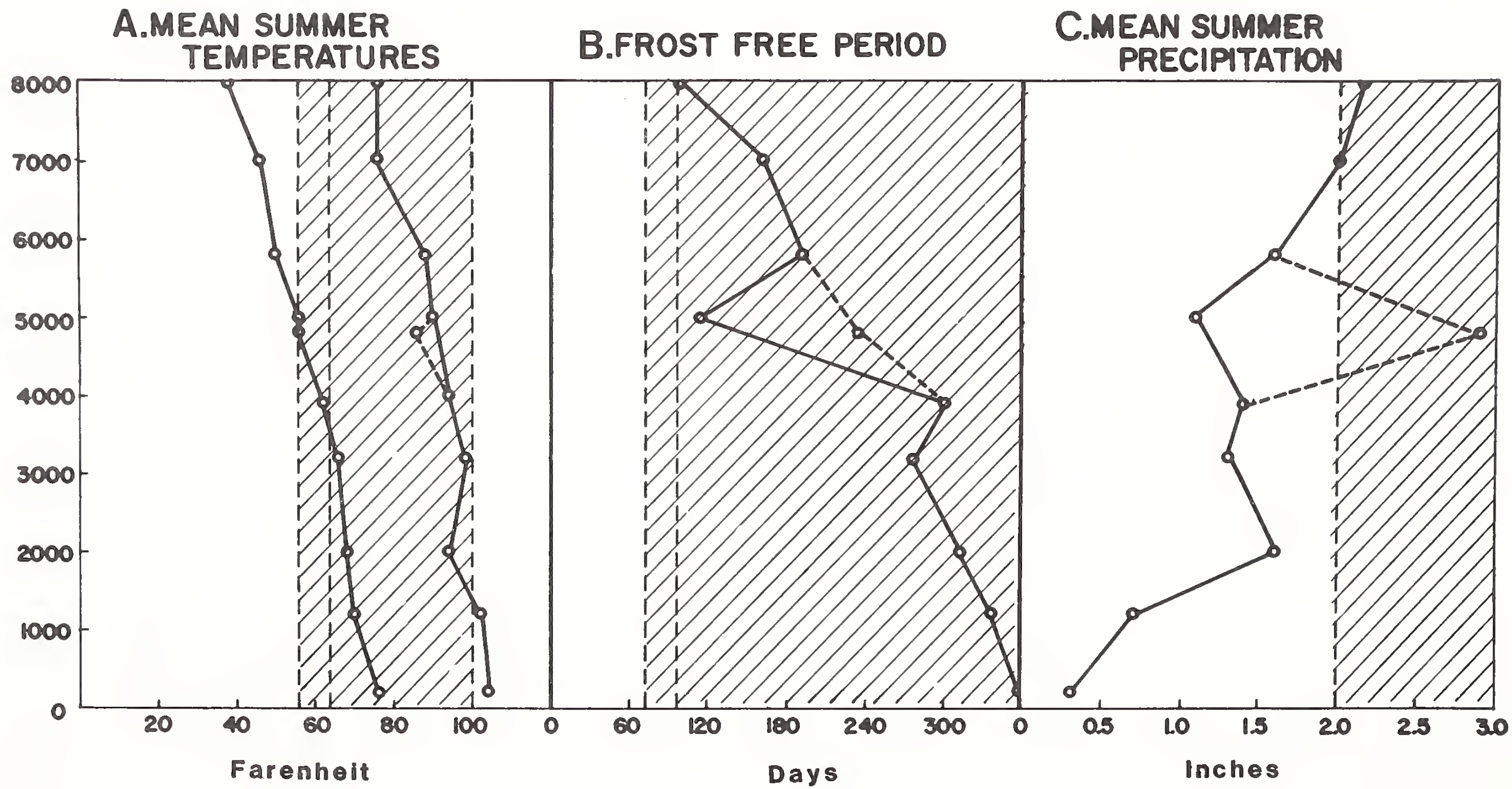

Figure 8. (a) Change of Mean Minimal and Mean Maximal Summer Temperature with Change of Elevation, (b) Change of Frost-Free Period with Change in Elevation, and (c) Change of Precipitation with Change of Elevation During the Summer Months.

proximate and interrelated to one another as well as related to more ultimate abiotic factors such as climate. For example, it has been recently demonstrated that climatic perturbations (as reflected by tree-rings) are strongly correlated with the rise and fall of deer populations on the Kaibab Plateau, presumably due to effect of climate on plant resources used as food (Young 1979). Predation (hunter success) and disease incidence parallel the rise and fall of deer populations. Animal populations, including human, therefore often exhibit zonal distributions, being concentrated relative to environmental resources. Movements from such normal zonal patterns then may reflect change in the distribution of essential environmental resources.

HUMAN EXPLOITATION OF THE COLORADO PLATEAU ECOSYSTEMS

Edible Biotic Resources and Their Spatial Distribution

The environmental resources of the Colorado Plateaus are highly variable but provide for humans such things as food (both plant and animal), timber for firewood and construction, plans for medicine, and bone, fur, mineral, and fiber for technological purposes.

Among the thousands of plant and animal species occurring on or near the Colorado Plateau are hundreds which could potentially provide sustenance to man and which could be obtained by simple hunting and gathering techniques. However, not all of these organisms are sufficiently numerous or provide sufficiently massive edible portions as to be worth the energetic expenditure requisite for acquisition.

Approximately 20 warm-blooded vertebrate genera and about 60 genera of seed plants do provide sufficiently massive edible parts and/or occur in sufficient abundance to have been potential food resources. All have been recovered from archeological proveniences on or near the Colorado Plateaus and many have been identified from human coprolites (Stein 1963, 1964; Stiger 1977; Hudgens and Hevly n.d.; Ward 1975).

When the biota potentially capable of providing sustenance are plotted according to their elevational distribution (Figure 9), one observes that the diversity increases from lower elevations to higher to about 6000 feet (1800 m) and then abruptly declines. Likewise, if the biomass of these organisms is examined in a similar fashion, maximum biomass can be obtained at an elevation of approximately 6000 feet (Figure 10).

The above data strongly suggest that if humans were to rely on such biotic resources for survival and apply optimal foraging behavior, a concentration of human populations should be found between 6000-7000 feet (1800-2100 meters) on and near the Colorado Plateaus. Such indeed was the case at the time of initial European contact in the 17th century. Assuming that current biotic distribution and climatic conditions existed in the past, one might anticipate that prehistoric sites would also be concentrated within the same elevational limits.

Indeed, examination of quantitative data on biotic resources per unit area in the Montaine Forest would suggest a very limited carrying capacity for humans and little likelihood of upward movement for occupation versus hunting and gathering excursions (Table 2). Nevertheless, structures suggesting protracted occupation were built well above 8000 feet (2438 m) at several localities on the Colorado Plateau and certainly provoke inquiry of how such populations supported themselves.

Climatic Patterns and Corn Agriculture

Each species has its own requisites of temperature and moisture for seed germination, seedling establishment, flowering, and maturation of fruit. Corn is a summer annual requiring adequate moisture (usually more than 2 inches (5 cm) of rain per month), warm temperature (usually above 65°F during the day and above 55°F during the night), and a long growing season, usually longer than 110 days (Collins 1913; Colton 1965; Delorit and Ahlgren 1953; Major 1951; Jenkins 1941; Maule 1963).

On a long-term basis, the growing season is usually more than required for corn at elevations below 8000 feet; however, temperature and moisture are significantly more limiting. While mean maximal temperatures are generally favorable for corn above 1000 feet (300 m) elevation, mean minimal temperatures are less than optimal above 5000 feet (1500 m). Summer

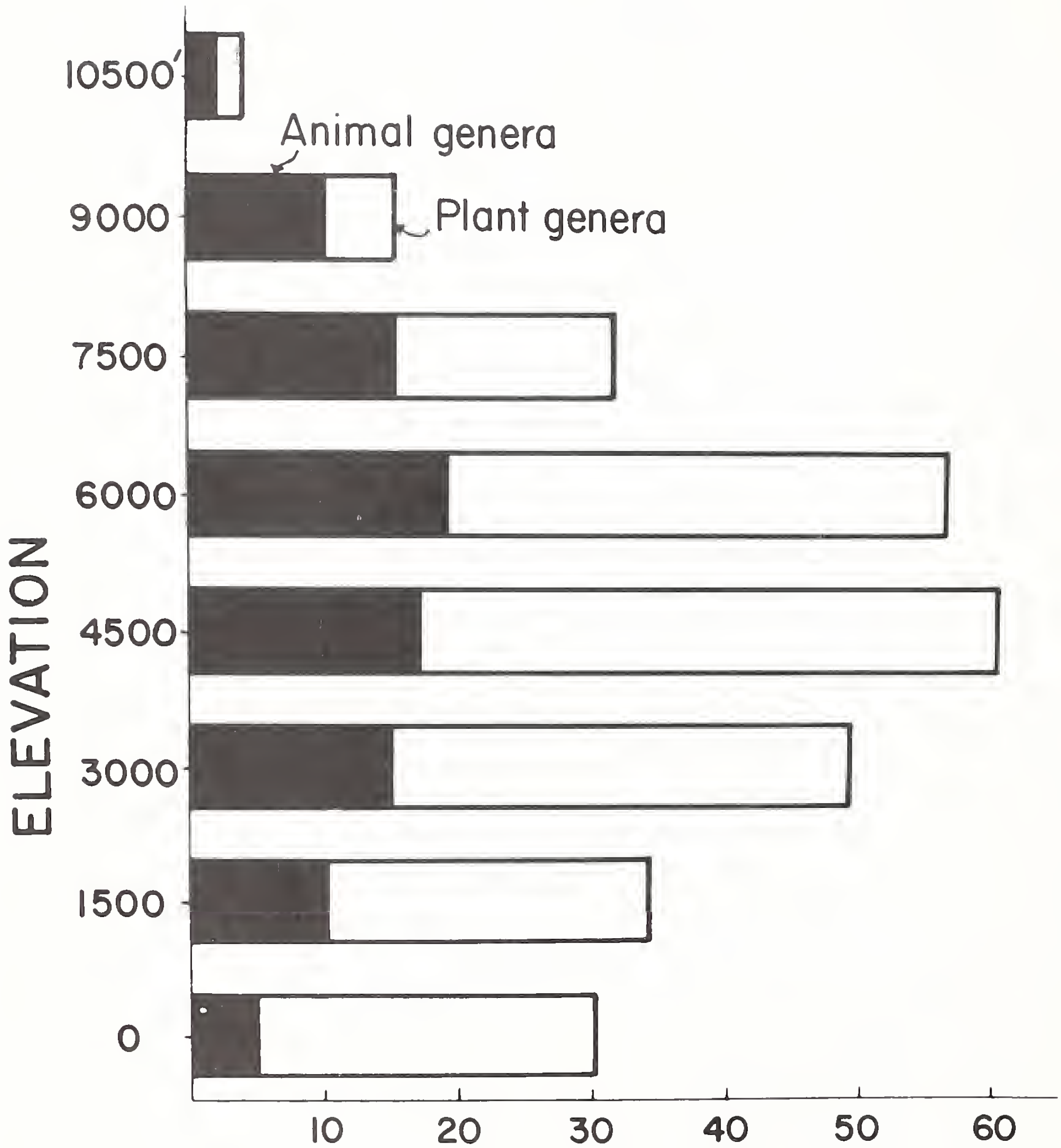

Figure 9. Number of Plant and Animal Genera at Different Elevations on or near the Colorado Plateau Which Might Potentially Provide Sustenance.

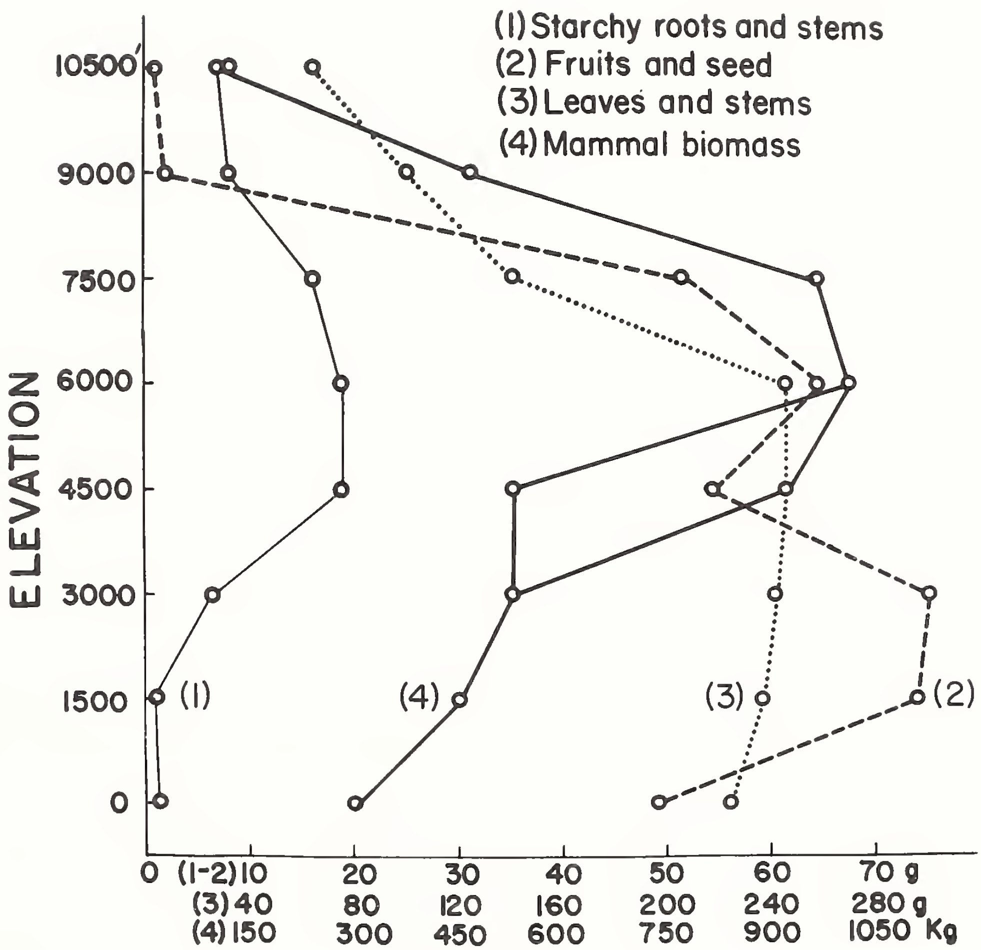

Figure 10. Changing Biomass of Plants and Animals (one edible unit of each species) Found at Different Elevations on or near the Colorado Plateau.

Table 2. Seasonal Food Availability and Carrying Capacity Per Square Kilometer in the Mixed Conifer Forest Community

Available Foods / Food Categories	WINTER	SPRING	SUMMER	AUTUMN
	Energy-Capacity -------- Units-Biomass kg	Energy-Capacity -------- Units-Biomass kg	Energy-Capacity -------- Units-Biomass kg	Energy-Capacity -------- Units-Biomass kg
Starchy Roots and Stems	2.864 = 0.0013 -------- 3.052 = 3.769[1]	2.864 = 0.0013 -------- 3.052 = 3.769[1]	2.864 = 0.0013 -------- 3.052 = 3.769[1]	2.864 = 0.0013 -------- 3.052 = 3.769[1]
Potherbs and Greens[3]	--------	12,277,369 = 5.4566 -------- 22,588.500 = 39,604.417[1]	4,844,583 = 2.1531 -------- 8,913.300 = 15,627.689[6]	398,185 = 0.1769 -------- 732.600 = 1,284.468[2]
Fleshy Fruits[3]	--------	--------	--------	232.00 = .1031 -------- 100 fruits x 0.1g 10,000 plants = 100,000
Dry Seeds and Nuts[3]	--------	--------	--------	368.00 = .1635 -------- 1,000 seeds x 0.1g 1,000 plants = 100,000
Large Mammals[4-5]	295.2 = .1312 -------- 0.34375 Elk[1] 0.22275 Deer = 147.6	295.2 = .1312 -------- 0.34375 = 103.1[1] 0.22275 = 44.5	295.2 = .1312 -------- 0.34375 = 103.1[1] 0.22275 = 44.5	295.2 = .1312 -------- 0.34375 = 103.1[1] 0.22275 = 44.5
Medium Mammals	.270 = 0.0001 -------- 0.1287 = 2.000[1]	.270 = 0.0001 -------- 0.1287 = 2.000[1]	.270 = 0.0001 -------- 0.1287 = 2.000[1]	.270 = 0.0001 -------- 0.1287 = 2.000[1]
Small Mammals *	42916 = 0.0190 -------- mice 1074[1] rats 43 squirrel 189 = 31.790	42916 = 0.0190 -------- mice 1074[1] rats 43 squirrel 189 = 31.790	42916 = 0.0190 -------- mice 1074[1] rats 43 squirrel 189 = 31.790	42916 = 0.0190 -------- mice 1074[1] rats 43 squirrel 189 = 31.790
Large Birds	No data, often migratory			
Medium Birds	No data	No data	No data	No data
Small Birds	No data	No data	No data	No data
Reptiles and amphi.	No data	No data	No data	No data
Fish	No data	No data	No data	No data

Footnotes - Table 2

[1] Total available units of food divided equally into the seasons of availability assuming equal harvest in these seasons (* = estimated numbers; . . . = food item unavailable). Data sources: Gaud & Jenness 1974.

[2] Energy shown is that of the biomass of the seasonally available food and is expressed in kilocalories. Carrying capacity is the potential number of people which could be supported if 100 percent of the available food is harvested. However, if such exploitation were to occur, such severe disruption of the environment and of the reproductive capacity of the exploited population would occur that human populations would not be able to exploit the same area for several years or decades. Experience of fish and game managers would suggest that harvest of 5-10 percent of animal populations can be tolerated in a sustained yield mode. In plant populations harvesting of more than 10 percent of the standing crop is possible over a number of years only if the land is fertilized. Thus only about 5-10 percent of the indicated human carrying capacity could permanently occupy the area.

[3] Since soils contain a reserve of seeds remaining viable for several years and plants will continue to produce fruit and seed for a number of years, these food categories could be harvested completely for several decades without significantly altering the carrying capacity; but, over a long period of time such harvest would ultimately prove detrimental, if 100 percent of the fruit and seed crop is continually removed.

[4] Large mammals (e.g., deer and elk) and birds (e.g., turkey and quail) may migrate during severe winter conditions while other including smaller taxa (e.g., bears and rodents) may hibernate; hence seasonal availability of mammals and birds varies greatly.

[5] Herd animals are assumed to be uniformally distributed resulting in a density of 1-2 animals per section and further assumed to be harvestable in any season; therefore, their number and biomass were seasonally fractioned.

[6] Numbers and biomass of organisms are based on populations currently existing at study sites in Coconino and Navajo Counties, Arizona. Some portions of these sites are subject to minimal grazing by domestic livestock. No attempt has been made to correct for this modern impact which would have been absent in prehistoric time and which today is far more significant in lower elevation plant communities. The impacts of prehistoric exploitation by humans are difficult to assess but probably also were more significant in lower elevation plant communities.

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precipitation is adequate at some stations at 5000 feet due to proximity of mountains (mass effect) but many stations below 7000 feet (2100 m) do not receive adequate moisture.

Soils must be moist for germination of any seed. Due to the seasonal distribution of moisture and the occurrence of a pronounced spring drought in Arizona, such moisture must be residual from winter precipitation if germination is going to occur before the onset of the summer rainy season. On the Colorado Plateaus winter precipitation is minimal below 6500 feet (1950 m) and except for microhabitats it is inadequate for the germination of corn seed until the onset of summer rains. Thus favorable moisture conditions occur at elevations generally unfavorable for corn agriculture due to mean minimal temperatures. Only the longer than essential growing season at this elevation permits the maturity of a crop in some years. At lower elevations the longer growing season may often permit crop maturity after onset of the summer rains or alternatively the dry land farmer may exploit especially favorable microhabitats (Hack 1942). Control of runoff water or irrigation permits agriculturalists to expand into fertile soils of the more arid lower elevation habitats. Therefore, until the adoption of water control technology it would be predicted that populations of agricultural peoples would be concentrated near permanent water sources or at elevations between 6000 and 7000 feet (1800-2100 m), assuming the current climatic conditions.

Demographic Trends of the Southern Colorado Plateaus

Interest in the density and settlement patterns of the prehistoric inhabitants of the southern Colorado Plateau area extends back in time several decades. Colton (1946), among others, early recognized a significant increase of population (as evidence by site and room number counts) during the 11th and 12th centuries. In the Flagstaff area he attributed this population increase to the creation of favorable habitats for agriculture by the mulching effect of cinder deposited by the AD 1066 eruption of Sunset Crater. Subsequent studies in the Flagstaff area have suggested that while population increase did occur, it was much less than suggested by Colton and actually was initiated prior to the eruption of Sunset Crater (Pilles 1979). Furthermore, the pattern of changing population density has been shown to occur at other localities not subject to coincident volcanism (Figure 11).

In the Flagstaff area, Stein (1964) has further suggested, on the basis of tree-ring dated sites, that a change of settlement pattern occurred about the time of expanding population (Figure 12). Subsequent studies in the same and adjoining areas have not significantly modified this pattern, if indeed the sample of sites examined is adequate.

POLLEN AND CHANGING ENVIRONMENTS OF THE SOUTHERN COLORADO PLATEAUS

The plant communities of the Colorado Plateaus exhibit a characteristic zonation reflecting individual species integration of edaphic mosaics and climatic gradients. Each of the modern plan communities can be further characterized by distinctive assemblages and proportions of pollen types (Figure 13). Such data can, by comparison with fossil pollen data, reveal the responses of plant species to changing environments of the past. These responses in turn permit inferences on the nature, magnitude, and duration of environmental changes and probable responses of animals, including man, to such changes.

The plant communities of the southern Colorado Plateaus are the result of millions of years of species evolution, extinction, and migration following the retreat of the Cretaceous inland sea and elevation of the land mass in the region of the present Colorado Plateau above sea level. This land mass, while initially colonized by warm-temperate to subtropical mesophytic forests, experienced the same aridification as the rest of western North America resulting from the formation of numerous mountain ranges. The plant communities underwent a major change of character as the broad-leaved hardwoods were essentially eliminated from regional floras and the narrow-leaved softwoods (conifers) persisted, becoming the dominant species in most floras. While some hardwood species were totally eliminated, others retreated to favorable microhabitats in mesic canyons and still others were able to adapt morphologically and physiologically to the progressively more arid environment (Nations et al., 1981).

The communities which we see today are the result of (1) Pleistocene tectonic, volcanic, and climatic events which created favorable habitats for colonization and corridors for migration; and (2) associations of species which are the product of Post-Pleistocene climatic change and species extinction or migration (Hevly and Karlstrom 1974; King and Van Devender 1977; Phillips and Van Devender 1974).

Several types of evidence have been employed to explore the nature, magnitude, and duration of post-Pleistocene climatic change on the Colorado Plateaus. Some data exist for the entire 10,000-year period but the most abundant and most precisely dated evidence has been obtained from tree-ring or ceramically dated archeological sites.

Tree-ring data provide both the temporal control of other proxy data as well as direct climatic inferences. Tree-ring data obtained from the lower elevational limits of the species employed for analysis primarily reflect available moisture of current and preceding season (Fritts 1965). Averaged 20-year mean departures of tree-ring widths from a standardized mean width reveal fluctuating past moisture conditions (Figures 14). Major droughts occurred in the early and late 700s, late 800s to earliest 900s, early and late 1000s, mid 1100s, and late 1200s. Major wet episodes occurred in the 600s, mid 900s, early to mid 1000s, early 1100s, early 1200s, and the early and late 1300s.

These fluctuating high frequency trends are

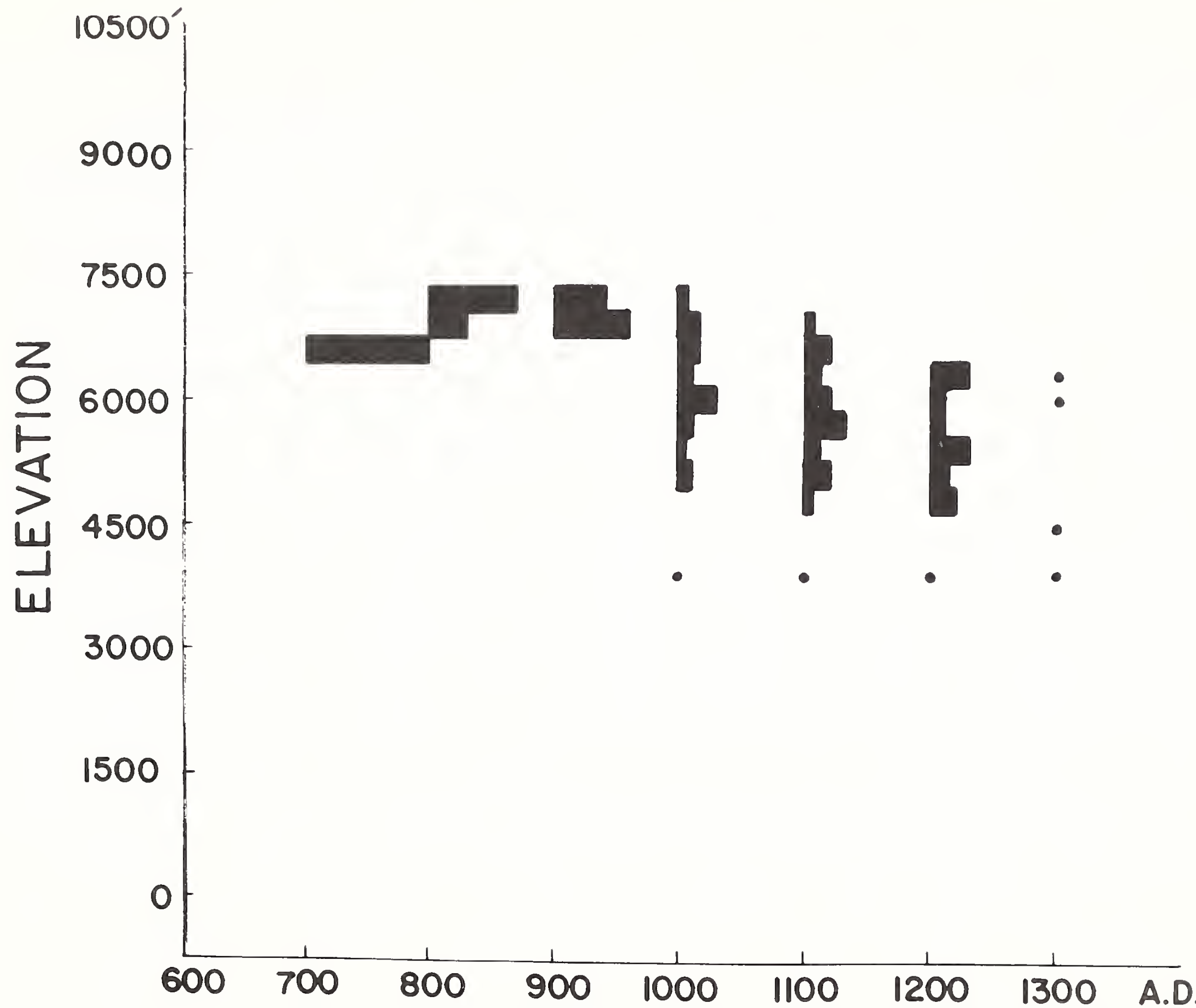

Figure 11. Percentage of Sites (mostly habitation) Found at Different Elevations During each Century near Flagstaff, Arizona.

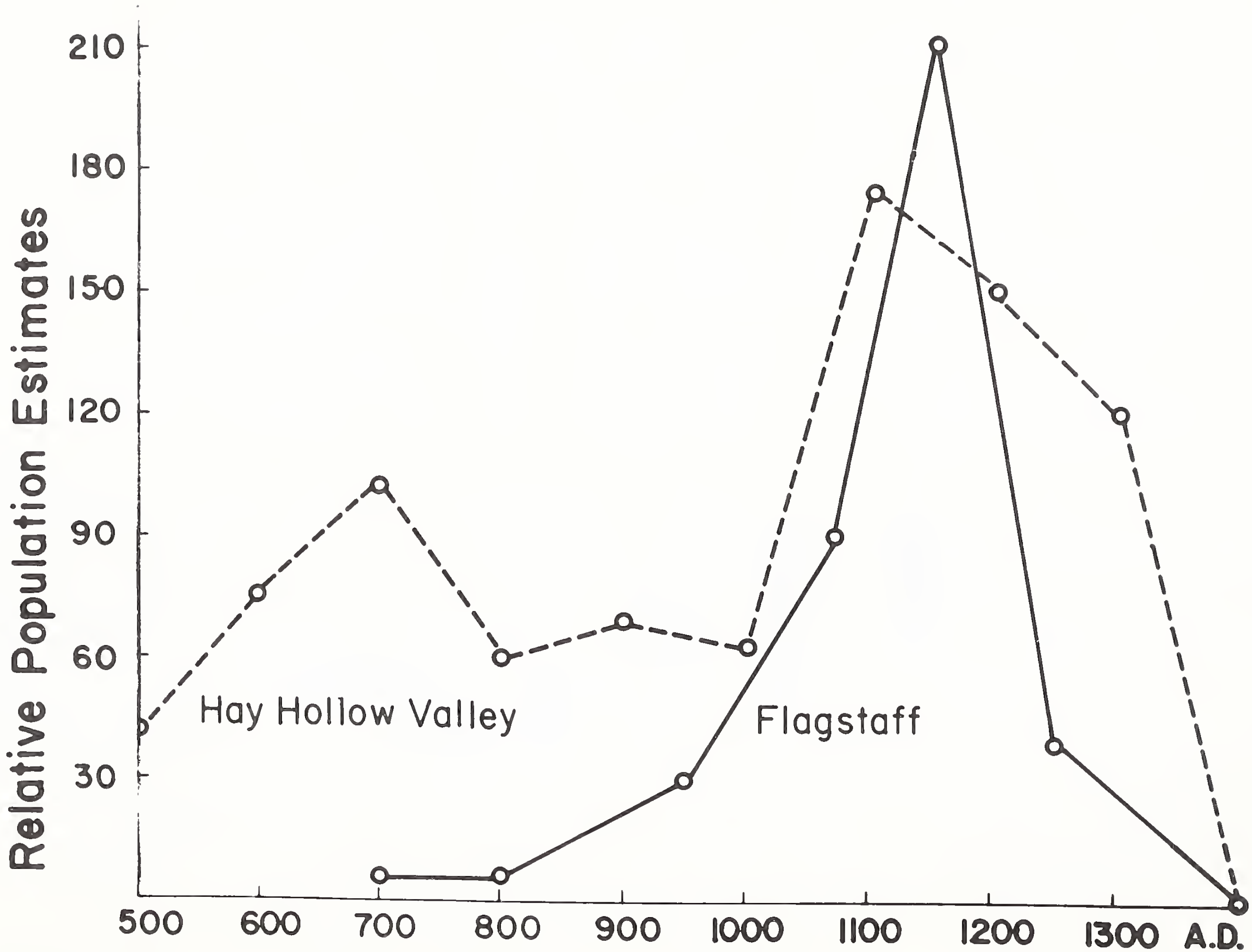

Figure 12. Relative Population Estimates (habitation units) in Hay Hollow Valley and Flagstaff.

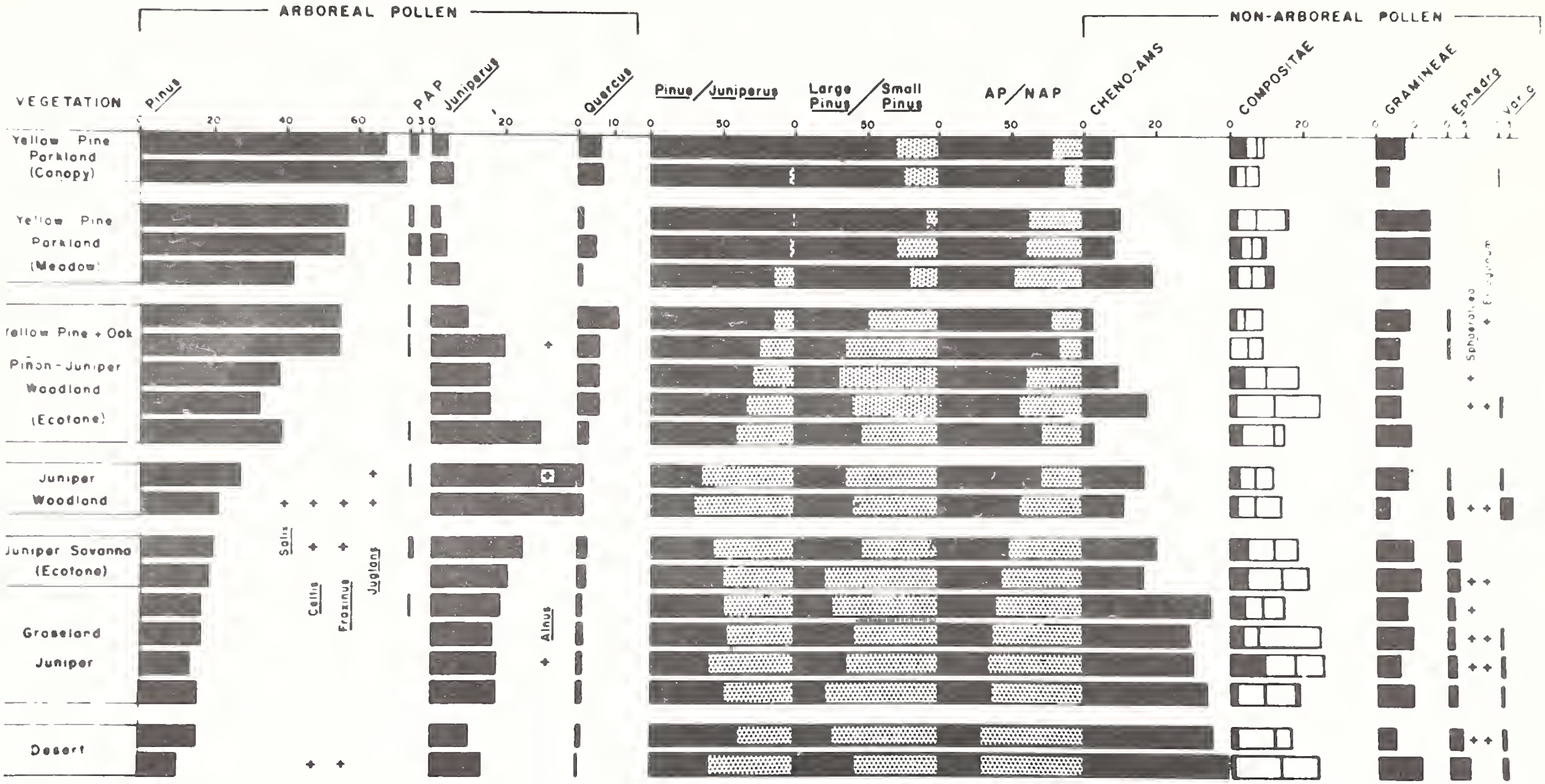

Figure 13. Comparison of Modern Pollen Spectra from Canopy and Meadow Areas within Pine Parkland, Woodland, Junipers, Savanna, Grassland, and Desert Vegetation.

also apparent in the pollen record but with differing amplitudes (Figure 14). These changes occur too rapidly to reflect actual altered floristic composition, but they may relate to such things as short term alterations of plant and animal productivity (Hevly et al., 1979; and Young 1979). It should be noted that in Hay Hollow Valley the changing composition of midden materials reflects the general climatic trends of the 13th century, including drought periods characterized by greater diversity of utilized native biotic resources and diminished quantities of cultigens. More mesic intervals of the same period are characterized by diminished diversity of native biotic resources and increased quantities of cultigens (Ware 1975).

Tree-ring data obtained from the upper elevational limits of the species employed for analysis reflect temperature and to a large extent available moisture (La Marsh 1974). The tree-ring records obtained from the upper altitudinal limits of a species are strikingly different from those obtained from the lower altitudinal limits. While tree-ring indices from the upper altitudinal limits of species from the Colorado Plateaus have not yet been published, they are available for one species, Bristle Cone Pine, in California. The trends shown there are of much longer duration (one or more centuries versus a few decades) and they are also reflected in other north Pacific and north Atlantic proxy data (Bergthorsen 1969; Dansgaard, Johnsen and Moller 1969; and Arakawa 1966). It is not unreasonable to assume that similar trends occurred further south in North America. In fact, the pollen data of the Colorado Plateaus more or less parallel those of the bristle cone pine (Figure 14). These changes are of sufficient duration and were apparently of sufficient magnitude that they brought about changes of the paleohydrologic regime (Euler et al., 1979).

PALEOECOLOGY IN RELATION TO PREHISTORIC DEMOGRAPHY

In general, the trends of pollen, hydrology, and tree-rings are also paralleled by the population trends known from several localities on the Colorado Plateaus (Figure 12). The above data taken in conjunction with other known events permit the following possible explanation of the demographic events occurring on the southern portion of the Colorado Plateaus.

Warm moist conditions of the seventh century AD permitted occupation by Basketmaker III peoples to occur within the zone of maximal biotic resource, at about 6000-7000 feet (1800-2100m). Conditions of increasing aridity during the eighth and ninth centuries A.D. prompted people to move to higher elevations to obtain requisite conditions for corn agriculture (other crops such as amaranth, beans, and squash should also be considered), or they altered subsistence strategies employing a larger proportion of deer and elk meat. Populations during this interval were diminished at some localities relative to their levels during the 600s (Figure 12). During the 900s water control measures were adopted in some areas and a corn race more resistant to drought was introduced into the Southwest. These cultural adaptations combined with the frequently more warm and moist conditions of the eleventh and twelfth centuries A.D. permitted expansion into the more arid lower elevation habitats and resulted in a significant overall increase of population on the Plateaus. Cooling climates of the 1200s and 1300s as well as drought progressively narrowed the zone which could be profitably exploited by the agriculturalists and resulted in diminished population levels overall.

This pattern is characterized by a concentration of sites at elevations at and above 6500 feet (1200 m) between A.D. 700 and 1000. Beginning in the 12th century, the sites appear to be dispersed over a broader elevational rung extending down to at least 4000 feet (1200 m) in northern Arizona. The upper elevational limit of tree-ring dated sites appears to progressively drop between A.D. 1000 and 1400. The period during which dispersion of sites over the broadest elevational range occurs is apparently coincident with the period of greatest population density (Figure 12).

Recently recognized demographic trends for the Colorado Plateau include inferences derived from decadal analysis of tree-ring dated structures and numbers of cutting dates per decade in northwestern New Mexico and southwestern Colorado (Euler et al., 1979) and for Arizona (Berry 1980). Regional periodicity of building activity and inferred increases and decreases of population are indicated. Increased

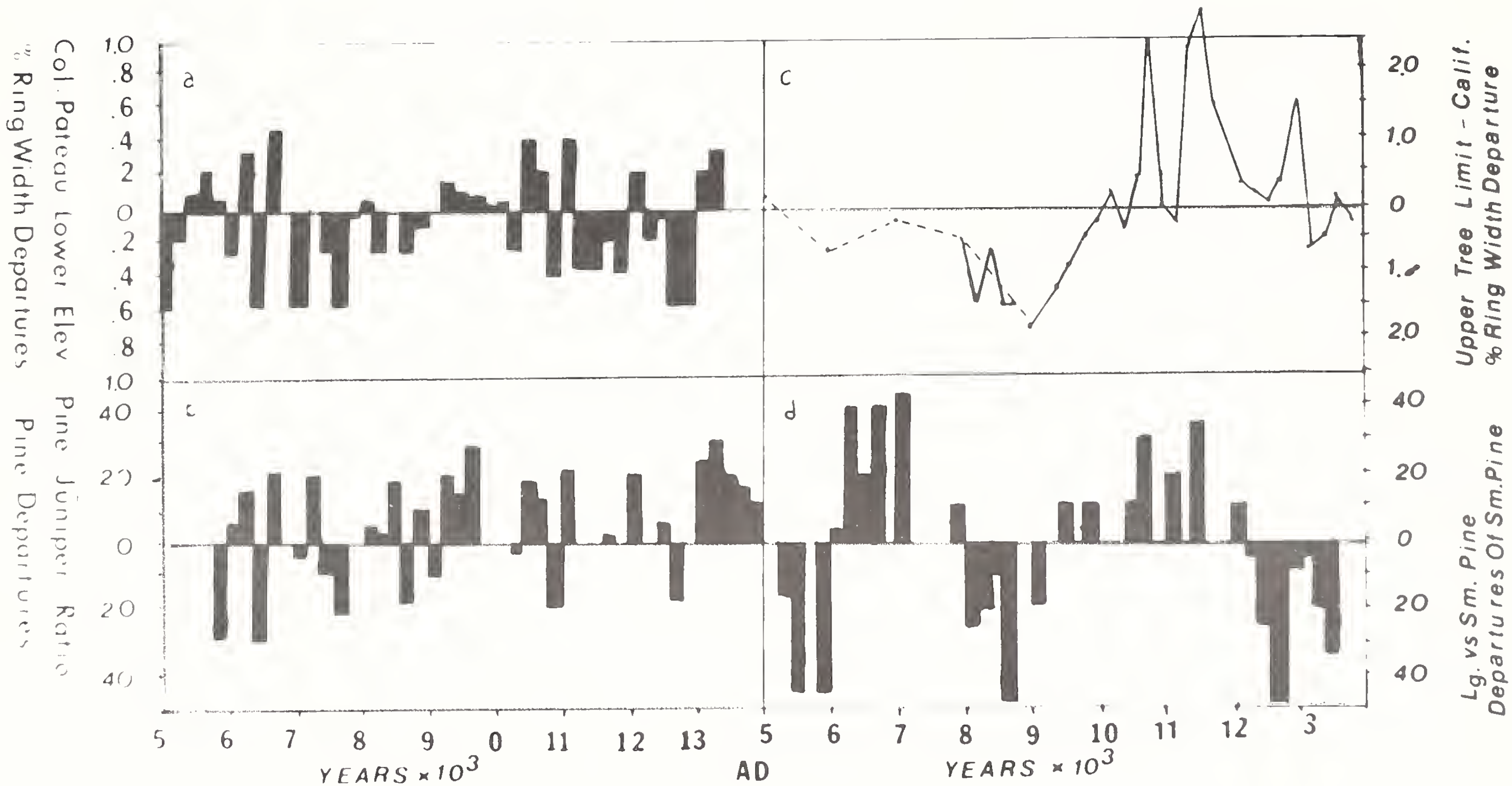

Figure 14. Temporal Comparisons of (a) Lower Elevation Colorado Plateau Tree-Ring Departures, (b) Pine Pollen Departures, (c) High Elevation Tree-Ring Width Departures, and (d) Departures of Small Pine Pollen.

building activity apparently occurred in the 600s, 700s, early 800s, late 1000s, early 1100s, and mid 1200s. Periods of diminished building activity can be recognized in the late 600s, 700s, about 900 and again in the late 900s, late 1100s, and in the late 1200s. Examined on a more local basis it is apparent that this pattern did not occur at all localities and, that in fact, reciprocal relations existed between some localities.

The changes in construction activity and site location through time both above and below the current optimal potential biotic resources elevational range of 6000 to 7000 feet (1900-2100 m) immediately suggest that one or more factors in the articulation of paleoenvironmental and human populations was altered. Such changes could be the result of one or some combination of (a) climatic change, (b) adaptations of agricultural technology, and (c) alterations of exploited biotic resources.

Superimposed on these general demographic trends were pulsations of population movements into refuge areas during severe drought episodes and their reemergence and the population of marginal areas during more mesic intervals. Refuge areas were of two types: high elevation areas in the more massive mountain systems, and lower elevations near permanent sources of water. The magnitude of movement was in some instances considerable but often such movement involved moves merely upslope or downslope in a given region. Ultimately, however, most areas of the Colorado Plateau were abandoned in the 13th century.

HIGH-ALTITUDE RESOURCE UTILIZATION IN ARIZONA

Fred Plog

INTRODUCTION

Any discussion of high-altitude environments in Arizona must begin with observation that these environments are extremely rare. Land surfaces in excess of 8000 feet (2438 m) cover less than one percent of the state and those over 7000 feet (2134 m) only about 5 percent. There are only three locations where high altitude environments cover a sufficiently large and archeologically known area that it is even reasonable to consider the possibility of adaptation to the area. Thus, this exercise is an effort to squeeze water from a very dry orange, if not from a rock.

The essay will proceed as follows. High altitude environments and their distribution through the state will be discussed. The environmental characteristics of these locations will be summarized as well as grounds for identifying differences between prehistoric and modern environments. The current state of our understanding of the prehistory of each of the areas will then be summarized, including estimates of the likely dates of occupation of each of the areas. Transformation processes that might affect our ability to clearly understand the prehistory of each of the areas will be discussed. Finally, alternative hypotheses concerning the processes that led to brief occupations of the various areas will be considered. It is necessary to note from the outset that there is no sense in which even relatively complete tests of alternative hypotheses will result from this effort.

THE NATURE OF HIGH-ALTITUDE ENVIRONMENT

The concept of high altitude environments would be easier to explore were such situations more abundant in the state. Even given greater recent attention to higher altitudes as a result of cultural resource management needs, the number of known archeological sites is small. There is no question that the basic adaptation of prehistoric peoples living in the state was to altitudes less than 7000 feet.

In the original version of this essay, I worked basically with a lower limit of 8000 feet in defining high altitude zones. At the School of American Research seminar, a decision was made to extend consideration down to 7000 feet. Because this altered definition resulted in considerable change in the nature of the local archeological record for some areas but not others, a pattern potentially important to understanding the nature of those adaptations, I will work with both definitions in this paper. Land surfaces over 7000 feet occur largely as patches in Arizona. The three largest areas are the Rim of the Grand Canyon, including the Powell, Kaibab, Walhalla, and Tusayan Plateaus, the San Francisco Peaks area around Flagstaff, and the Sierra Blanca area near McNary (Figure 15). Medium sized areas are the northern edge of Black Mesa and the Chuska and Lukachuki Mountains and along much of the Mogollon Rim. Small patches occur around Navajo Mountain, the Mingus Mountains, and at the highest elevation of the various sources to the Coronado National Forest in southeastern Arizona.

As a group, these high altitude areas share a number of environmental characteristics. Average annual precipitation is at least 15 to 20 inches (38 to 51 cm), and in the highest elevations it is in excess of 30 inches (76 cm) per year. Thus these are the wettest environments in the state. However, it is worth noting that, because of the typical storm tracks through the state, there are lower altitude environments that receive just as much moisture. In fact, there is almost as high a percentage of the state's landsurface below 7000 feet that receives 20 or more inches of rain in the average year.

The average annual July temperature in these high altitude environments is 60° to 70°F. This range is, of course, much cooler than lower elevation areas on the plateau. The average January temperature varies markedly between high altitude environments in the northern and southern halves of the state. The average January temperature in northern high altitude environments is 30°F., while in the south the mean is 40°F. The average number of frost free days is about 120 in the north and about 140 in the south.

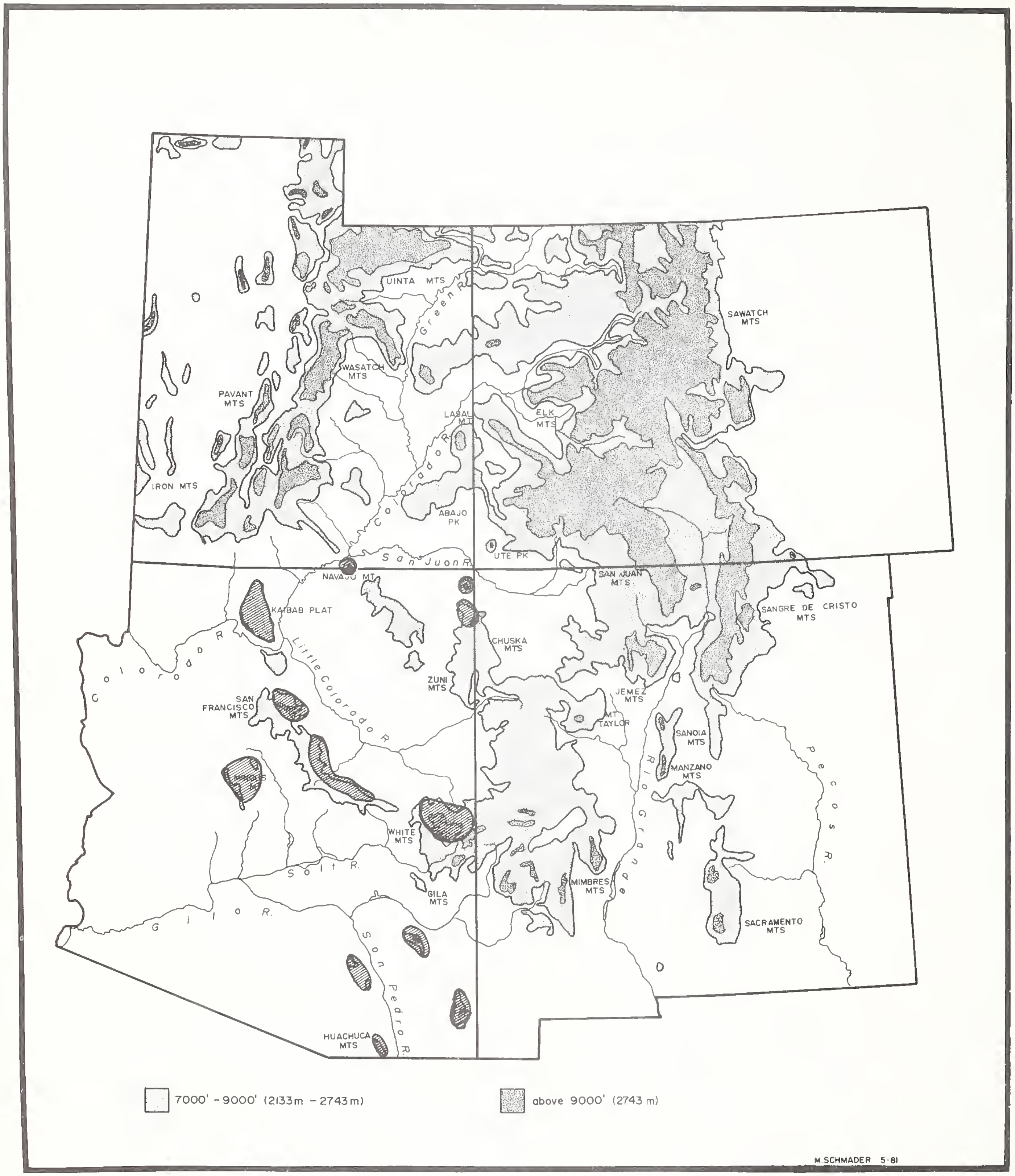

Figure 15. Major High-Altitude Studies in Arizona, shown by diagonal lines.

The dominant flora surrounding high altitude environments and at the lower elevations within them is best described as a montane conifer pattern, specifically ponderosa pine forest. Along with ponderosa pine, typical plants in this pattern include buckbrush, fernbush, Gambel oak, fendlerella, currant, New Mexican locust, elder, manzanita, rabbitbrush, sage, cliffrose, Apache plume, mockorange, ninebark, raspberry, ocean spray, grape, cliffbush, and boxleaf myrtle (Lowe 1964:69). Plans of the juniper-pinyon woodland, mountain meadow, and other coniferous associations occur as stands within the ponderosa. Juniper-pinyon woodland covers some of the lowest of the elevations under consideration. At higher altitudes spruce-fir forests are typical.

In addition to spruce, these forests include aspen, oak, alder, birch, and maple. Smaller plants are essentially either those of the lower ponderosa forest or the higher meadows.

At the highest elevations the landsurface is covered by mountain meadows. Typical meadowland grasses include mountain timothy, Arizona fescue, mountain muhly, dropseed, needlegrass, mountain brome, Arizona wheatgrass, and Kentucky bluegrass (introduced) Lowe (1964:48). Sedges, rushes, and "wildflowers," as well as berries such as currant, blueberry, grape, and raspberry often occur on the fringes of meadows.

Cross-cutting these altitudinally zoned communities are riparian habitats. At the highest altitudes, these are commonly lined with dense stands of willow. A variety of edible leaf and root plants line the streams. At lower elevations associations of cottonwood and walnut are more typical. Grapes and berries are among the edible foodstuffs in these areas.

The distribution of fauna over the high altitude environments is difficult to treat using any zonal patterns. While the density of animal life is generally less abundant at higher altitudes, most of the animals with the exception of birds and rodents are relatively similar over the areas. Bear, deer, elk, rabbit, coyote, and beaver are examples.

In general, the soils of the Arizona's high altitude environments are thin. That is to say, in most areas extensive areas of rock outcrop or thinly developed soils on rock outcrops are typical. However, stream valleys and the derived sediments of some formations do produce deeper soils. Mineral resources are relatively rare in these environments.

THE NATURE OF PREHISTORIC HIGH-ALTITUDE ENVIRONMENTS

Not all environmental variables are equally likely to have changed during the period of human occupation of Arizona. Therefore, each of the major subjects will be discussed separately. Generally, the geology and topography of an area are less likely to change during any specified time period than, for example, precipitation patterns. Nevertheless, in the case of at least these specific high altitude environments some changes did occur. First, in both the San Francisco Peaks and Sierra Blanca areas there is evidence of vulcanism that is at least potentially within the last 20,000 years. Second, in both of those same areas there is evidence of at least two and more likely three epochs of glaciation within this same period. The most recent occurred in the vicinity of about 3000 years ago (Pewe and Updike 1970; Merrill and Pewe 1972).

Thus, there is a possibility that prehistoric human occupants of the area lived in areas where volcanoes were active and where glaciers occurred. Similarly, in some localities the ground surface has been substantially modified by these activities.

Both pollen (Schoenwetter 1962; Hevly 1964b; Schoenwetter and Dittert 1968; Briuer 1977) and tree-ring (Dean and Robinson 1977) studies inform our understanding of variation in temperature and precipitation patterns in the past. Both indicate that there has been substantial variation. Tree-ring studies from A.D. 680 to the present show some decades during which rainfall was likely to have been as much as two standard deviations above and below the conditions observable at present. However, variation at any one point in time is substantial from one locality to another. In any given decade, the difference for the northern Arizona area generally between the station with the narrowest and widest rings is 1.67 standard normal units. Since modern storms in the area average about 10 miles (16 km) in

diameter with several internal cells of 1 to 3 miles (1.6 to 4.8 km), such variation is not surprising. Finally, the dendroclimatic data for the area suggest decreasing equability from A.D. 680 to the present. Unfortunately, the location of recording stations does not allow one to comment specifically on the conditions of high-altitude environments. It is possible that the magnitude of both short term and long term variation in these environments was less than at lower elevations. Pollen studies have been used to identify periods of greater and lesser effective moisture in the Colorado Plateau area generally. Again, data that are specific to high-altitude environments are rare. Thus, the most useful summary is that generated by Schoenwetter (1962) for the Colorado Plateau area generally. Schoenwetter notes periods of drought at A.D. 210-265, A.D. 1085-1125, A.D. 1275-1315, A.D. 1560-1600, and A.D. 1900-1910. Wetter periods occurred between A.D. 300 and 375, 525-575, 625-675, 1025-1070, 1210-1240, 1335-1425, 1450-1475, 1600-1620, and A.D. 1815-1830.

There is little reason to believe that one can comment with anywhere near the same degree of precision on temperature. While it is certainly reasonable to believe that changes in annual mean temperature as well as means for particular seasons did occur, specific documentation is difficult. The alternation of cool, wet and warm, and dry years that can be documented, using existing records is likely to have been characteristic of the environments in question during at least the last 2000 years.

Hydrological variation over the Colorado Plateau is generally substantial. However, if there is an exception to the year to year and channel to channel variation in streamflow that is characteristic of so much of the area it is in high altitude environments. Because stream flow depends on stored precipitation in the form of snow as well as on rainfall, relative permanence of high altitude streams is a reasonable expectation. This is not to argue against some variation in the quantity of steam flow, but only for relative permanence of the streams themselves.

Soil studies in the environments in question are generally limited.

Studies of prehistoric geomorphology are more than limited. Unfortunately, those studies that have been done tend to assume an extreme form of uniformitarianism and extrapolate the results of limited localities to vast areas. Given the known climatic, hydrological, and vegetative variability over the Colorado Plateau the efficacy of such generalizations is dubious.

Pollen analyses are the best source of our understanding of differences in vegetative patterns for the northern part of Arizona. At the end of the last glaciation, the spruce fir community grew at the margins of at least one lake that is located 2,000 feet (610 m) below the modern lower limit of that community (Hevly 1964a:185). Thus one must imagine that the high-altitude environments of this period consisted of alpine meadows and tundra. In more recent times Hevly suggests that an altitudinal variation of 500 vertical feet (152 m) in the location of particular community boundaries is likely to have occurred. Given this much vertical variation in environments and those under discussion, substantial differences in the composition of high-altitude vegetation is possible. There is some evidence for hickory and elm in the area as late as 3000 B.C. (Bruier 1977). Similarly, there may have been significant changes in the relative importance of particular species, oak for example. Our current understanding of variation in the distribution of fauna during the prehistoric period is nonexistent.

While the preceding discussion has emphasized common aspects of high-altitude environments, it is important to recognize that important differences also occur. A quick comparison of the North Rim and the Sierra Blanca areas should make this point clear. The elevated surface of the North Rim ranges between 7500 and 8500 feet (2286 and 2591 m) while that in the Sierra Blanca area goes as high as 10,500 and 11,500 feet (3200 and 3505 m) on the two highest peaks in the area. The land-surface of the North Rim is a flat upland dissected by deep north/south trending canyons. The land-surface of the Sierra Blanca area was formed by vulcanism. There are successive major escarpments as one goes up the mountain slopes with small mountain valleys oriented in a variety of directions between.

Rainfall on the North Rim averages 27

inches (69 cm) per year. At comparable elevations in the Sierra Blanca area averages are between 13 and 25 inches (33 and 64 cm) per year. It is only at much higher elevations that rainfall averages exceed 27 inches (69 cm) per year. Of the hundreds of measures of climatic variation (Visher 1954) the two areas differ in respect to only a handful. On the North Rim, a relatively greater percentage of annual precipitation falls during the winter and the area tends to stay a bit cooler during the spring. In the Sierra Blanca area, precipitation falls on a greater number of days, precipitation is extremely high in the wettest years, and there is frost most nights during the year. The Sierra Blanca area is one of the most efficient for plant growth not simply in the Southwest but on the continent; it compares favorably with the Northwest Coast and with the borders of the Gulf of Mexico.

There are few permanent springs or streams on the North Rim while these are regular occurrences in the Sierra Blanca area. Ponderosa is the dominant vegetation on the North Rim with some spruce fir and alpine meadow communities at the highest elevations. These same elevations in the Sierra Blanca area are covered by ponderosa mixed with some juniper-pinyon woodland; spruce-fir and alpine meadows generally occur at far higher elevations.

This last paragraph suggests the manner in which this discussion tests the meaning of the concept "adaptation." These two high altitude environments are markedly different. I suspect, although I do not have the pertinent information, that a comparison with high altitude environments in southern Arizona would detail even starker contrasts. Nevertheless, in light of some of the similarities in cultural resources that will be discussed later, it is interesting to ask what aspects of these areas might have led to their use in similar ways.

CULTURAL RESOURCES

At present cultural resources are most completely described for the North Rim, Sierra Blanca and Flagstaff areas. It is on these three areas that the discussion will focus with other localities mentioned in relation to them. One must note that while these three environments are more completely described, information is less than would be desirable for addressing the issues at hand.

Euler, Jones, Effland, and Chandler (1979) have succinctly and informatively summarized our current understanding of the prehistory of the north rim of the Grand Canyon. In addition to surveys that they undertook, their conclusions are based on prior investigations (Hall 1942; Judd 1926; Schwartz 1970; Schwartz and Kepp 1977; Teague and McClellan 1978; Thompson 1971, 1975; Thompson and Thompson 1978). While these investigations do not focus on the very highest elevations in the areas, they are pertinent to the issue of high altitude utilization.

Site density averages about 33 per square mile, (2.59 km^2), with a room density of around 123 per square mile. This figure is quite high not simply in comparison with nearby localities, such as the Grand Canyon and its south rim, but also in comparison with most of the plateau Southwest. Sites appear to have been occupied between A.D. 900 and 1150, although a concentration in the period between A.D. 1000 and 1150 is not unlikely.

A variety of potential determinants to settlement location have been considered. Settlements occur up to elevations of 8250 feet (2512 m). Sites are equally distributed between pinyon-juniper and ponderosa habitats. Rooms, however, occur in greater density in the higher elevation ponderosa forest, although the difference (80 versus 105 per square mile) cannot be shown to be statistically significant at present. Proximity to obvious sources of water does not seem to have a major effect on site densities. Sites occur on ridges, but they could hardly occur elsewhere given the ubiquitous distribution of this landform in the area. Site and room densities are roughly eight times higher in locations with good access to the grand canyon. Thus, transport to the canyon bottom would appear to be a major factor.

Both habitation and limited activity sites occur in the area. Limited activity sites are most commonly soil and water control features; there are few artifact scatters recorded in the surveys. Habitation sites can be divided into two groups: one to two room sites and three or more room sites. The latter are distinctive in regard to the size and array of rooms. Sites are

generally not larger than about ten rooms. All sites are very evenly distributed over the study area.

Cartledge (personal communication) has provided additional information on the very highest local altitudes. Sites are very rare, but one quite large artifact scatter at 8800 feet (2682 m) has been noted. This artifact scatter seems to represent repeated use of the spruce-fir/alpine meadow boundary for several thousand years.

About 60 sites were recorded on the Walhalla Plateau (Swartz, Kepo, and Chapman 1981). While there is minimal evidence of a Basketmaker presence in the area, the major occupation began sometime after A.D. 950. Population in the area apparently began to increase at about A.D. 1050 and was in decline by A.D. 1100. The Plateau was abandoned by about A.D. 1150.

Early sites include a variety of agricultural features and one, two, and three structures. Just prior to abandonment, one room structures were rare and two four room or larger sites existed in the area. Palynological evidence of the use of corn, beans, and squash was recovered. Hunting seems to have been focused on larger game animals. The authors interpret the brief period of settlement in the area as colonization during a period of increased moisture. Abandonment occurred at the return of drier conditions on the Plateau.

The Sierra Blanca area has been described in somewhat more detail in a volume edited by Plog (1978). Articles by Francis, Hantman, Jewett, Lightfoot, and Wood (all in Plog 1978) as well as earlier efforts by Danson (1948), Long-acre (1970), and DeGarmo (1975) are the source of specific analyses concerning cultural resources and prehistory (referred to in the volume as the Little Colorado Planning Unit).

In the Sierra Blanca high altitude environment site densities are far lower than on the Kaibab Plateau, averaging about 12 sites per square mile. Similarly, rooms average about 28 per square mile. This figure is low not simply in comparison with the Kaibab Plateau but also in comparison with nearby areas and the plateau Southwest generally. Occupation of the area occurred between A.D. 1070 and 1300, but was concentrated in the decades A.D. 1100.

Again, there is some considerable understanding of the local determinants of site location. Sites occur between 7200 and 8200 feet (2195 and 2499 m). Limited activity sites tend to occur at the highest and lowest elevations. Those at low elevations are usually artifact scatters while those at the highest elevations are historic and prehistoric shrines. Small habitation sites tend to occur at low elevations, but larger ones are most typical at between 7600 and 7800 feet (2316 and 2377m). It is worth noting that sites above 8200 feet are extremely rare even though most of the local land surface is above this elevation. Sites occur almost exclusively in stands of juniper pinyon woodland. Similarly, high quality soils and the quantity of arable land are important determinants of site densities. While sites generally occur on ridges, this statement is again more a truism than a discovery. There is no clear connection between site densities and the availability of water.

A number of different kinds of sites occur. Protohistoric and prehistoric shrines occur at the origin point of drainages, on the tops of peaks, and at very high-altitude springs. Sixty five percent of the sites are limited activity sites and the majority of these are artifact scatters. Habitation sites again fall into two groups: those with one or two rooms and those with four or more. The latter differ in layout and in respect to the addition of features such as kivas. While an eight or ten room site is very large, sites of up to 30 to 50 rooms do occur. The distribution of sites over the area is very highly clustered.

Lowering the definitional boundary to 7000 feet results in little change in the preceding. An additional area of settlement near Lakeside with characteristics almost identical to the Sierra Blanca area is added to the data set. Two sites near Heber are at 7000 feet and are in an area where the site density is high virtually up to this limit.

In the Flagstaff area roughly 667 acres ($2699 km^2$) on landsurfaces at greater than 8000 feet elevation have been surveyed. A total of 26 sites, including one "psychic site" (a 150,000 year old site where a rock slide crushed a women, child, and pony, the latter loaded down with bags of wheat and rye) have been recorded. Eight of the

sites are prehistoric including two Archaic sites (one Agate Basin, one Pinto), one lithic scatter, two artifact scatters, one shrine, one pictograph, and one quarry. Interestingly, there is no conclusive evidence of habitation units. The overall site density of eight sites per square mile is lower than that encountered thus far.

USDA Forest Service records for the zone between 7500 and 8000 feet include 23 prehistoric sites. Culturally, these sites are either Sinagua or Cohonina. Surface pueblos, pithouse villages, pueblos, field houses, and artifact scatters are found. Dates on the sites range from about A.D. 800 to about A.D. 1150, and do not seem to cluster in any particular time periods.

Hundreds of sites have been recorded on landsurfaces between 7000 and 7500 feet. A full range of site types is present. The occupation began at about A.D. 700 and lasted until around A.D. 1150. There is an apparent higher density of sites between about A.D. 1000 and 1150. Thus, this pattern would seem to parallel that seen on the Walhalla Plateau. In light of the very high density of sites below 7500 feet, the limited number of higher elevation sites would seem to reflect a relatively random utilization of higher elevation areas. Nevertheless, the large number of sites found above 7000 feet, and this is only a sample of the total present, would suggest that prehistoric peoples in this area were adapting to high-altitude conditions throughout most of the prehistory of the area.

For the remainder of Arizona, data are spottier still. Pertinent portions of the Kaibab National Forest have not been surveyed to date. I was unable to obtain any pertinent information for the small portion of the Prescott National Forest that is legitimately high altitude. There are no high altitude environments on the Tonto National Forest. Above 6500 feet (1981 m), two one-room pueblos, one large cliff dwelling, and numerous artifact scatters are known. However, sites on this forest occur largely below 6500 feet. I was unable to obtain pertinent archeological data for the Lukacukai and Chuska Mountains. Only a single high altitude site, a shrine, has been recorded on the Coronado National Forest, but surveys have occurred in the Navajo Mountain area. While it is unclear how much intensive survey was done at elevations above 7000 feet, some of this high-altitude area was surveyed and a few sites were found. However, the vast majority of sites around Navajo Mountain area are at elevations below 6500 feet.

In summary, there are three areas of the state with significant evidence of settlement in high altitude environments: Sierra Blanca, Flagstaff, and the North Rim of the Grand Canyon. Apparently permanent settlements occur in all three of these areas. In addition, water control features and/or field houses are present in all of the areas. Some cermonial use of the environment is suggested by shrines in the Flagstaff and Sierra Blanca areas. Shorter term resource acquisition is indicated by artifact scatters, quarries, and, perhaps, some of the more ephemeral structures.

TRANSFORMATION PROCESSES

Given the apparently great variation in site densities in the areas just discussed, it is appropriate to ask whether transformation processes could account for variation in site densities. More specifically, one might ask whether there are transformation processes that affect high-altitude environments to greater or lesser degrees than lower altitude ones. Likewise, it is important to know whether there may be transformation process that affect some high altitude environments more than others. Both natural and cultural processes must be considered.

Natural Transformation Processes

Some of the evidence suggesting changes in the nature of prehistoric environments in the areas under question was mentioned earlier. Here I intend only to note the potential effect of these changes on the archeological record that is recoverable today.

First, in the Flagstaff and Sierra Blanca areas there is evidence of glaciation including an epoch as recent as 3000 years ago. Since most of the sites in the North Rim and Sierra Blanca areas are more recent than 3000 years ago, there is little chance that the difference in site densities between them is a product of glaciation. However, any subsequent research that indicates differential densities of Archaic or PaleoIndian remains

will need to carefully address this question.

Second, significant vulcanism occurred in the Flagstaff and Sierra Blanca areas but not in the North Rim area. In the case of the Sierra Blanca area, evidence of vulcanism suggests that it might have obscured only the earliest human activity in the area. Volcanic activity in the Flagstaff area is more recent. While it is my impression that most of the recent activity is at elevations too low to be of concern for the current question, the relation of variable site densities to vulcanism throughout the Flagstaff area is an important issue.

Third, the soils and depositional/erosional processes in the Sierra Blanca and Flagstaff areas, while highly variable, include some deep soils forming on volcanic or glacial sediments. The soils in the Kaibab area, because they are developed on the relatively tough Kaibab limestone, are far more shallow. Thus, there is a higher probability of burial of relatively early sites in the two former areas. Since the very highest altitudes in the Sierra Blanca and Flagstaff are also among the wettest in the state and given these deep soils, the level of geomorphic activity is higher. In combination with, for example, heavy trampling by animals in the vicinity of springs, the probability of an ephemeral site disappearing in mucky streamside or springside soils is much higher.

Finally, the spruce-fir forest presents the most difficult survey conditions that I have encountered in Arizona. The density of trees is very high as is the density of fallen logs and duff cover. In more open areas, grass and brush are denser than in lower elevation communities. In comparison with lower elevation environments, the probability of finding sites is probably lower even if densities are equivalent. Probably the best current evidence of this problem is the dearth of evidence of low density artifact scatters at high altitudes when they are relatively common at lower altitudes. Thus, both overall density estimates and the relative importance of specific site types may be effected.

Cultural Transformation Processes

Given that high altitude sites are known principally through survey at this time, it is close to impossible to discuss the effects of later prehistoric inhabitants of the area on sites occupied by earlier inhabitants. The activities of our own society are the more crucial issues. One can suggest arguments involving cultural transformation processes that lead to the conclusion that high altitude sites are likely to have been less heavily impacted by cultural transformation processes and others suggesting that they are likely to have been more heavily impacted.

If one focuses on pothunting and casual collecting, these activities are less likely to have affected high altitude than low altitude sites. Previous studies (Lightfoot and Francis 1978) suggest that access is a major factor in predicting the impacts of pothunting and collecting. Since high altitude areas are among the least accessible in the state, the average routine site in them should be less heavily impacted. However, there are some categories of sites for which this argument would not hold. First, springside locations seem to be important in some areas. Since hunters and backpackers visit these springs, sites in the vicinity suffer, at least potentially, greater impacts. Similarly, there is considerable awareness that spring and peak shrines often contain beads and other "goodies." Since the potential location of shrines can be identified from even relatively gross maps, shrines tend to have been relatively greatly impacted.

Because of the economic value of ponderosa pine and fir, a great deal of lumbering has occurred in high altitude environments. Undoubtedly, sites have been destroyed or obscured by this activity. Nevertheless, ponderosa pine forest occurs at elevations lower than those under discussion and land modifying activities that are at least as destructive as timber harvesting, e.g., juniper pushing, occur there. Thus, in respect to these major activities, it is difficult to see that the problems of cultural transformation processes in high altitude environments are in any sense unique.

This discussion has not in any sense demonstrated that density and other cultural patterns in high altitudes are the product of transformation processes. It has been suggested that there are both cultural and natural processes that could have produced such patterns. Unless these are carefully

controlled in efforts to explain human utilization of these areas, the potential of mistaking apparent for real patterns will be great.

PATTERNS OF HIGH-ALTITUDE RESOURCE UTILIZATION

I have used both the concept of utilization and adaptation in the paper. Clearly, utilization is an aspect of adaptation, but the reverse relationship can hold; an organism can use the resources of an area without the behavior having any substantial adaptive significance. Thus, it would be very surprising indeed if prehistoric peoples did not occasionally venture into high-altitude environments and utilize some of the resources available there. Whether such trips were of major consequence for the survival of Southwestern individuals and groups is an open question. Equally open is the question of whether such visits would have left a sufficient density of evidence that we would have any awareness of them today. It is even possible that resource acquisition activities critical to the survival of local groups might have left little evidence. Trips to streamside environments to collect roots and leafy plants that would have almost certainly been available during the drier part of the year are an example. The technology required for this activity is minimal and large quantities of the plants can be taken in a short period. Thus, there is no good reason to anticipate that human residues either in the form of tools or camp sites would have been left behind.

With these problems in mind, the next sections will review the extent of our current understanding of resource utilization, and use information concerning the cultural resources of the North Rim and Sierra Blanca areas in an effort to understand the nature of patterns of adaptation/ utilization.

Resource Utilization

Geology

Evidence for prehistoric utilization of the geological resources of high altitude environments is limited. As noted earlier, these resources are themselves limited, to the extent that one focuses on major mineral resources. There are no areas of Arizona where mundane raw materials such as those used for building stone or even for chipped stone tool manufacture are so limited in quantity that one would need to postulate trips to high altitude environments. The major exception to the preceding is obsidian. The best obsidian deposits in the state, those in the vicinity of Flagstaff, do occur in or near high altitude environments and there is evidence of their utilization.

Landforms

The landforms of high altitude environments are distinctive in one sense. There are no areas where human transport is more difficult. Thus, it is possible that high-altitude environments may have been used by prehistoric peoples who wanted to avoid or minimize contact with other groups. I prefer not to refer to this behavior as defensive behavior, but only as avoidance. The specific landforms of the North Rim area may have been the reason for the utilization of this location. In comparison with the dissected surface in the Grand Canyon, the relatively flat parallel ridges of the North Rim may have provided the most extensive farmable landsurface in the area. Since the soils there are relatively thin and were enhanced by the construction of water and soil control devices, the landform rather than the soils seems a likely reason for utilization by agriculturalists.

Climate

It has been argued that climatic factors were primarily responsible for high-altitude settlements in the Sierra Blanca locality. It had also been suggested that during a period of dessication or drought rainfall would have been both more substantial and more regular at high altitudes. Similarly, since drier conditions were likely to have been warmer, the growing season may have been sufficiently longer to permit agriculture. This hypothesis remains a viable one. To the extent that high-altitude environments are vertical environments, a great range of climatic conditions will be found and these may allow an agricultural people the flexibility they require for successful crop production.

Soils

Streamside deposits in high-altitude environments should be of exceptionally high quality for agriculture, although this condition will certainly depend on the bedrock and sediments which the streams tap. There are, however, no conclusive data indicating such utilization. That site and room densities in the Sierra Blanca area are higher in the vicinity of arable soil, which is exclusively valley bottom soil there, is certainly suggestive. Similarly, it is possible that prehistoric peoples living in or near high-altitude streams could have planted crops there with minimal modification of the ground surface.

Fauna

It is certainly possible that at some specific times of the year prehistoric peoples visited high-altitude environments to secure game. Today, for example, the high-altitude surfaces of Escudilla near Sierra Blanca are preferred sites for hunting deer and elk. However, there are no major game species that are unique to high-altitude environments. Similarly, these environments do not sustain the highest animal biomass. In all likelihood, preferred hunting areas would have been at lower elevations.

Flora (Maintenance Resources)

Fuelwood may have been a limiting variable in many areas of the Southwest. Given the dense high-altitude timber stands, timber may have been an important resource of the areas. However, the difficulty of transport through high-altitude areas suggests that timber would have been used only when supplies were completely exhausted at lower elevations or by peoples occupying high altitudes. All relevant evidence is conjectural at present. These same arguments would hold for construction timbers. Willow, a resource largely restricted to high-altitude environments, may have been important to prehistoric basket making.

Flora (Subsistence Resources)

Of the approximately 50 wild food plants used by Puebloan groups (Hopi, Zuni), about 15 grow at altitudes above 8000 feet. Another 15 grow at altitudes up to about 8000 feet. The average upper limit for these food plants is 7800 feet, and all grow at elevations well below 8000 feet, the majority down to 6000 feet. Thus, no strong argument can be made that high-altitude environments would have been an optimal location for obtaining wild plant foodstuffs. Some species do, of course, grow in greater abundance at higher altitudes, and, in dry years, many species unavailable at lower altitudes might be available at higher ones. Of those species whose ranges extend well into the high-altitude environment, the vast majority are plants from which either berries or greens were taken and these resources are generally ones that were available during the spring months.

On balance, I am reluctant to base an argument on any observation that a given species is more abundant at high altitudes. First, the species are generally available at the lower altitudes within these zones and their distribution would have been sensitive to prehistoric climatic changes. Second, these distributional observations are modern ones and do not take into account the enormous changes in vegetation that have resulted from the use of southwestern environments. Given the obvious visual differences between high-altitude and lower environments, variation in available foodstuffs is far less and results from plant species that people did not eat. The primary prehistoric utilization of these locations was likely to have been for berries and greens during the spring months. During especially dry years and periods these same and even a wider range of resources might have been exploited for a more extensive period and might have been more critical to survival.

Thus, there is a measure of proof of utilization of high altitude environments only for obsidian, landforms, and soils. Without excavation data, it is doubtful that clear evidence of patterns of utilization will proceed further.

INTERPRETATION

On balance, the principle clues concerning resource utilization and adaptation to high-altitude environments must come from settlement pattern data as these represent virtually the only sources of our current knowledge. Cultural resources present in the North Rim, Flagstaff, and Sierra Blanca areas, the only ones for which information is sufficiently abundant to attempt

generalization, were summarized earlier. Only in the Flagstaff area is there a record of prehistoric occupation that is comparable to lower altitude areas in the state. From about A.D. 700 to 1150, the density of population there was comparable to other areas of the northern Southwest.

Future research concerning the nature of high-altitude adaptation in the state must clearly focus on this area. The records for the North Rim and Sierra Blanca areas are quite different. It is useful to review briefly the nature of variation in the evidence of prehistoric use of these areas.

Low density artifact scatters: This category of cultural resource is not abundant in either of the two localities. My inclination, given that they do occur nearby, is to take their absence as evidence of the effect of natural transformation processes.

Water and soil control structures: While present on the North Rim, these are absent near Sierra Blanca. While one cannot conclude that agriculture was not practiced in the Sierra Blanca area, one may conclude that it was probably a less intensified practice.

Pithouses: That no pithouses were noted in either area is not necessarily remarkable. That no sites appearing to date in the interval between the Descert Culture and about A.D. 1000 is quite remarkable. Given that evidence of Archaic sites does occur, it is difficult to see how one could attribute the absence of pithouse villages to transformation processes. That these environments were not of interest to groups of this time period suggests that their utilization is associated with increasing reliance on agriculture or attendant economic or organization problems.

Great kivas and compounds: One would not expect to find either of these architectural forms on the North Rim as they are largely unknown for the Kayenta area. However, their absence in Sierra Blanca, especially since they are present nearby, suggests the absence of sites at which the central political, economic, or ceremonial functions with which these are associated occurred, or at least the absence of organizations producing the southwest's closest analog to monumental architecture.

Given these data, there are four potential interpretations of the high-altitude settlements in the North Rim and Sierra Blanca localities. First, these occupations could represent distinctive cultures adapted to high-altitude conditions. I know of no evidence that supports such an interpretation. The material remains in the two areas are quite similar to those that can be found in adjacent lower altitude zones.

Second, adaptive specializations within a larger (regional) cultural system might be indicated. This interpretation seems a reasonable one in the case of the North Rim. The site density there is very high in part because of a very large number of agricultural features. Moreover, sites are located in proximity to places where access to the canyon bottom is easy. Thus, transport between the rim and the canyon bottom seems to have been a major concern. High quality agricultural loci are limited in the canyon bottom. Thus, the high-altitude sites may reflect the use of the best available proximate agricultural land either seasonally by canyon dwellers or permanently by groups exchanging resources with inhabitants of the canyon bottom. In the case of Sierra Blanca, such an interpretation is more difficult. Neither arable lands nor flora and fauna are distinctive in comparison with lower altitude situations. While climate is distinctive, conditions are too variable and severe for successful agriculture if the overall pattern of variation is similar to that of the present. Timber harvesting is a possibility, but there is not even suggestive evidence at present.

Third, these locations might have served as refugia during periods of climatic stress. The relatively short occupation spans for the North Rim and Sierra Blanca are consistent with such an interpretation as is their very general correlation with a stressful epoch on the Colorado Pleateau. However, this interpretation fails to take into account the relatively extreme microclimatic variation that is typical of vertical, high-altitude environments. While it is true that higher elevations are warmer and remain relatively more wet during generally dry periods, the complexity of the land surface creates lacunae of favorable as well as dramatically unfavorable conditions. In this regard, it is important to note that high-altitude

locations settled prehistorically are almost identical to those settled at lower altitudes; little sensitivity to changed environmental conditions is indicated. Were the notion of these areas as refugia convincing, one would anticipate many more people for a longer period of time or one would need to be able to demonstrate the availability of sufficient arable land to feed lower altitude groups. What ultimately convices me that this argument is an unlikely one, however, is the extent to which demographic trends in these areas follow those of nearby ones. Population peaked in both areas at about the same time that population peaked nearby, and fewer people began to occupy fewer but larger sites at the ends of the sequences. Such parallels would be unlikely for refugia which should experience more boom-bust types of growth patterns.

Population expansion is a final possibility. This argument is improbable in the case of the North Rim since the population of this locality is higher than that of nearby lower altitude environments. However, in the case of Sierra Blanca it is appealing. Lightfoot (1978) has noted that lower altitude arable land was probably insufficient to support the population that lived there. Euler et al., (1979) and Jorde (1977) have noted the manner in which population expanded out of a contracted into the most favored agricultural locales during the last several centuries of Southwestern prehistory. It seems possible, then, that the high-altitude sites near Sierra Blanca simply represent an extreme case of such an expansion during the population peak in nearby areas. Interestingly, and consistent with this argument, the site distribution near Sierra Blanca is clustered, the pattern one would expect during a colonial period (Hudson 1969, 1974). (Equally interesting, the distribution for the North Rim is dispersed, the pattern one would expect in an area where settlement patterns had "matured," where space was being used efficiently.) The tendency of the "colonists" to locate in microenvironments similar to those that they used at lower elevations and the short occupation span are also consistent. On balance, population expansion seems to me a more likely explanation for the occupation of Sierra Blanca than one based on postulated refugia. The effort to use the area does, of course, appear to have been markedly unsuccessful.

CONCLUSION

Prehistoric populations almost certainly used the resources of high-altitude environments in Arizona. In three areas where utilization reached a point where the construction of permanent facilities was desirable, the patterns of utilization appear to have been quite different. Thus, it appears that high-altitude environments in different parts of Arizona were used differently and the manner in which they were used was dependent as much on the environmental adaptation of nearby people as on the conditions of the high-altitude environments themselves. Finally, while the use of one environment seemed to represent a real adaptation, the use of the other two were short term and a failure.

PART THREE: HIGH-ALTITUDE CULTURAL RESOURCES IN UTAH

HIGH-ALTITUDE SITES IN UTAH

Evan I. DeBloois

INTRODUCTION

As the Regional Archeologist for the Intermountain Region of the Forest Service from 1970 to 1980, the author became acutely aware of the paucity of archeological knowledge of high-altitude areas in Utah, Nevada, Idaho, and Wyoming. Project after project proposed by the Forest Service involved elevations of 8000 feet (2440 meters) above sea level and higher. Examinations of these areas showed clearly that aboriginal use had occurred at extreme elevations, but great difficulty was encountered in placing much of this evidence in cultrual and chronological context. Most of the reason for this difficulty was the almost total absence of research at these elevations.

As the result of 10 years of archeological survey by the Forest Service, considerable numbers of archeological sites have been identified at elevations ranging from 8000 to 12,000 feet (2440-3660 meters). Unfortunately, these data are almost exclusively surface survey data as precious little excavation has been undertaken. Forest Service policy for avoidance has resulted in the conservation of hundreds of sites that might otherwise have been destroyed or damaged, but has produced very few excavations that provide data to fill this gap in knowledge.

The purpose of this paper is to summarize some of the data assembled by Forest Service projects on lands in southern Utah. The sites selected for discussion are either above 8000 feet (2440 meters) above sea level or involve excavations that have yielded data pertinent to this research and are close to the minimum elevation range (Figure 16).

The use of 8000 feet as the cut-off point for high altitude sites is obviously arbitrary, but it serves as a beginning point for reviewing the past 10 years of site information collected by the Forest Service and others in Utah. Although 8000 feet frequently coincides with the boundary between the pine-fir forest and the oak-serviceberry brush zones in southern Utah, precipitation patterns influence that distribution as do other factors. Since the division does not follow any particular environmental or geographical lines, it is likely that similar sites will be found both above and below this elevation. However, setting a boundary is necessary to start with in order to determine what kinds of cultural remains are found at high altitudes. Dropping the elevation to 7000 feet would greatly increase the data base for this paper, but a larger selection of sites to examine is not needed at this point. Limiting ourselves to 8000 feet and higher still leaves nearly 500 identified sites on the three southern Utah National Forests.

The Forest Service policy, in response to limited staff and funding, has been to locate cultural resources and then modify projects if necessary to avoid any impacts. As a result of this general approach, thousands of sites have been identified from surface evidences, but only a handful have been more than superficially examined. Only when avoidance cannot solve the problems of a project, have excavations been carried out. Hence, of nearly 500 prehistoric sites located on the Dixie, Fishlake, and Manti-LaSal National Forests above 8000 feet, only a dozen have received any excavation, and most of this work has been limited to testing.

As a result of this approach to resolving management problems, a considerable backlog of what are classified as "unevaluated" sites has accumulated. These are sites whose cultural and/or chronological context has not been determined. It is becoming increasingly obvious, however, that this approach is not solving management problems, but merely postponing them. In an effort to avoid some of the inevitable confusion that will occur when the agency must face this ever growing backlog, efforts have been made to test sites that have unusual importance or that appear to contain data that might contribute significantly to answering questions about chronology, cultural affiliation, and cultural

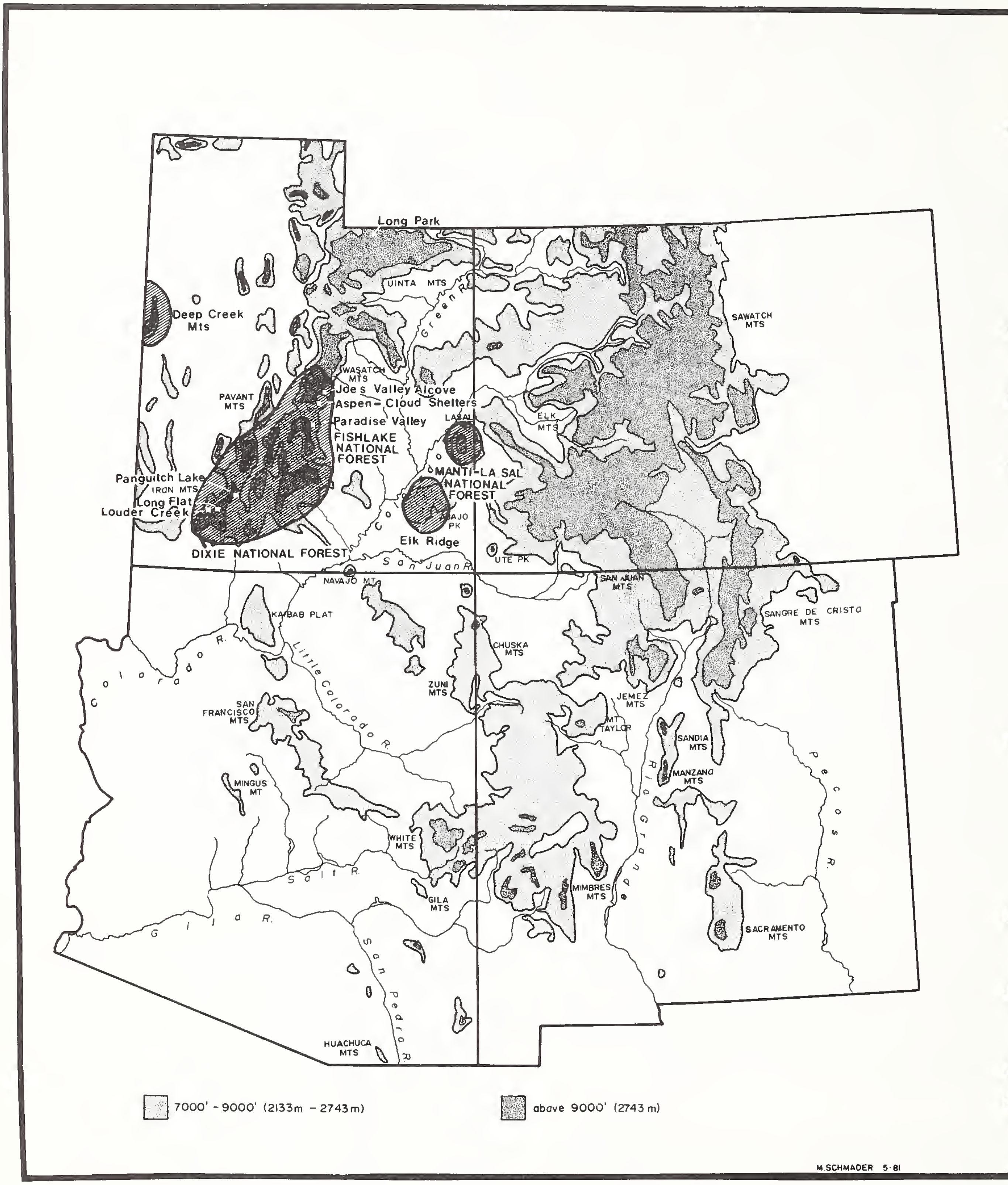

Figure 16. Locations of High-Altitude Studies in Utah, shown by diagonal lines.

systems.

Although these efforts have been minimal, the results are, nevertheless, useful because of the scarcity of data from such areas. These data may also be useful in suggesting future directions for research in high-altitude adaptations. In addition, the application of various methods of site examination to these sites might also be of some value in evaluating the relative success of various approaches. A large number of the sites are classified as limited activity areas and consist of unstratified, surface scatters of limited kinds of artifacts. Methods for extracting useful cultural information from these scatters need to be perfected.

The problems faced by land managers are very closely allied to the interests of archeologists in these high sites. Without adequate information to permit decisions to be made about the relative importance of these sites to the scientific community, the agency cannot successfully manage them. Justification of various management alternatives requires fairly precise information about what values will be lost or gained. Since the value of the prehistoric sites reported here is scientific, quantification and qualification of these values are necessary.

Another issue related to the management of National Forest System lands is the creation of wilderness areas. Since many, if not all, the proposed wilderness areas involve high altitudes and since there appears to be a potential for limiting access to sites in such areas, it is important that a dependable data base be established for the evaluation of high-altitude sites. Recent legislation creating the River of No Return Wilderness may provide an opportunity to further the ideas expressed in this volume. Congress has directed the Forest Service to prepare a cultural resource management plan based upon survey and excavation data. Since much of the area is high elevation, the opportunity exists both for benefiting from the discussions in this volume as well as providing input to future discussions of high-altitude adaptation.

Other wilderness areas are being and will be considered. Some may make similar considerations of prehistoric sites mandatory as well. As this occurs, our information on high-altitude sites will be appreciably expanded.

HIGH-ALTITUDE RESEARCH IN UTAH

Typical of most areas in the Intermountain Region, a list of published references to archeological research in high-altitude areas in Utah is pregnantly short. There is Hunt's survey work in the LaSal Mountains (1953) survey and testing in the Deep Creek Mountains of western Utah (Lindsay and Sargent 1979), and the analysis of lithic materials from the LaSal Mountains (Green 1974). A test of random sampling strategies in the Milk Ranch Point area (DeBloois 1975) was based upon survey data that bordered on the 8000 feet lower limit of this report.

A number of unpublished reports that describe high-altitude sites include a substantial number of short survey projects conducted by the Forest Service. Beginning in 1971 and increasing in numbers annually, these reports represent a valuable body of data on high-altitude cultural materials. Some of the more important of these reports describe salvage excavations at Joe's Valley rockshelter (DeBloois, Green, and Wylie, n.d.), test excavations at Long Park Reservoir (DeBloois 1976), a test of collection strategies at a lithic scatter near Panguitch Lake (DeBloois 1975), a survey of Paradise Valley (Hauck, McDonald, and Lucius 1978), test excavations at Aspen-Cloud Shelters (DeBloois 1979), testing at a lithic scatter near Lowder Creek Bog (Sargent 1979), and the survey and testing of 11 sites in the Fishlake National Forest (Simms 1979). These reports are mentioned because they include more than the usual surface survey results. A lengthy list of other projects could be assembled that have resulted in the identification of several hundred sites above 8000 feet.

In examining the references assembled, it is clear that research in high altitudes is both a recent phenomenon in Utah and a direct result of federal programs. What these references give the reader is an incomplete description of a variety of archeological sites, only a few of which have been explored more than superficially.

Survey of the LaSal Mountains

Hunt's survey of the LaSal Mountains of

southeastern Utah resulted in the location of 350 archeological sites, 119 of which were found in the aspen-fir zone above 8000 feet. An indication of the view held by many archeologists until recently about the utilization of higher elevations is found in Jennings' remarks in the preface to the report:

> Mrs. Hunt, unaware that the Indians did not spend much time in the high mountains, discovered over 350 sites in the very limited (500 square miles) LaSal Mountain area; 119 of these lie higher than 8000 feet, and about half of these are higher than 10,000 feet (Hunt 1953:ii).

In spite of this verification of the existence of considerable numbers of sites at the extremes of elevation in the state, few archeologists showed any interest until recently in following up on high-altitude investigations in other locations in the state.

What Hunt's survey suggested was a shift in site type from low to high elevations. This shift was supported by the divergence of artifact types and assemblages from low to high elevations. Projectile points from mountain sites were generally large, corner-notched types associated with Archaic occupation, while those at low elevations were smaller Anasazi, Fremont, and Shoshonean types. Manos and metates also varied between the uplands and the lowlands. The mountain metates were flat slabs with shallow oval grinding surfaces unlike the deep trough and basin metates of the lower canyon sites.

Pottery, common in lowland sites, was virtually absent in the mountains as was any evidence for dwelling structures. This variation in high and low elevation sites led Hunt to conclude:

> The contrast between the types of artifacts found at mountain campsites and those found in the dwellings in the canyons suggests that (a) the horticultural canyon dwellers rarely visited the mountains, or (b) if they did visit the mountains, they used an entirely different tool assemblage while there. But the differences between the mountain sites and canyon sites are so numerous. I infer that the horticultural canyon dwellers rarely went higher than the pinyon-juniper zone, and that the mountains were occupied by a different people, perhaps at a different time, than were the canyons (Hunt 1953:9).

Hunt saw three different environmental zones in the LaSals, the Canyon zone below 6000 feet (1830), the Foothill zone of pinyon-juniper forest between 6000 and 8000 feet, and the Mountain zone above 8000 feet. Many of the artifact types she identified were found in only two adjacent zones. The pinyon-juniper zone is a transitional location for artifacts of the upper and lower zones. The only artifacts found in a single zone belonged to the Canyon zone. Most of these represent characteristics of Anasazi Culture--masonry construction, petroglyphs, trough metates, and loaf-shaped manos.

Since most of the affiliation of sites above the Canyon zone from Hunt's survey is determined by projectile point styles, particular attention must be given to these items. A single lanceolate point from the Mountain zone is identified as Angostura. It is the only PaleoIndian point reported. Gypsum points are well represented in the Mountain zone as are large corner-notched points of the Elko series. Another early Archaic type, called Elko split-stemmed (Aikens 1970) or Pinto Basin (Holmer 1979), is common but not in the Mountain zone. All the small points, Rose Spring corner-notched and Desert side-notched, are found in the Canyon and transitional (Foothill) zones but are absent from the Mountain zone.

The Mountain zone tool kit contains large corner-notched projectile points, a variety of knives, drills, scrapers, metates, and manos. This kit suggests the exploitation of plant and animal resources common to that zone.

Although such a conclusion seems plausible, the effect of forest cover on archeological inventories has been shown to greatly skew results. The frequency of meadow edge sites has been shown in other areas to be more a function of surface visibility than anything else.

One of the major unanswered questions about site distributions across the landscape is the degree to which vegetation, alluviation, and "arrowhead hunting" bias the data with which we are dealing.

Lithic Analysis in the LaSal Mountains

Although the work carried out by Green (1974) involved sites below 8000 feet, it was an effort to substantiate several of the conclusions reached by Hunt and demonstrated some of the regional variation in prehistoric use at similar elevations. The report is based upon the survey and collection of 23 sites in the pinyon-juniper forest zone on the southwest flank of the LaSal Mountains, in which Green intensively surveyed blocks of land proposed for disturbance. The survey was carefully delineated and the area examined to locate all sites within the project. Careful collections of all types of artifacts were made to provide representative examples of the range of materials present. Stimulated by the location of considerable numbers of Anasazi field houses at 7000 to 8000 feet on Elk Ridge (DeBloois 1975), Green also looked to find such sites to verify or rejects Hunt's claim that these sites did not exceed 6000-7000 feet. Another motive for the project was the differentiation of hunting camps from gathering camps based upon variations in tool assemblages.

The results of the study pointed out a number of difficulties inherent in most high-altitude sites: (1) small numbers of artifacts, particularly diagnostic tools, (2) absence of dateable materials, and (3) inability to measure the amount of previous collecting. Although all artifacts were collected on 21 of 24 sites, only 14 yielded more than 25 artifacts for analysis. Only 11 projectile points were recovered, seven from just two sites. In spite of these limitations, Green was able to confirm Hunt's observation that structures were absent at elevations above 7000 feet. Green also pointed out the homogeneity of the sites. Unable to separate hunting from gathering tool assemblages, Green urged continued research in this area. In spite of this lack of success, this study exceeds Hunt's efforts in dealing with site specific problems and points out the difficulty faced by the archeologist in extracting useful cultural data from these ephemeral sites.

Survey in the Deep Creek Mountains

The work by Lindsay and Sargent (1979) in the Deep Creek Mountains is a notable improvement on Hunt's work in its approach to the problem of area size. Sampling environmentally stratified areas of the region gave them a view of each zone with sampling bias controlled. Similar problems were encountered, however, with low site numbers and limited diagnostic tools. Results support the use of high altitudes from Archaic to historic times with remarkably little variation. Perennial streams are seen as prime locations for sites in the mountains although only five of the eighteen sites found were above 8000 feet.

Paradise Valley

The survey of Paradise Valley in south-central Utah (Hauck, McDonald, and Lucius 1978) is of particular interest here because of the large number of sites located above 8000 feet, and the unique features of the area. Paradise Valley is a high mountain valley on the eastern edge of the Gunnison Plateau. The lowest point in the valley is about 7900 feet above sea level. Sometime in the past the valley contained a lake that drained to the east through a well-defined channel. Lake terraces are not well defined, showing a rather steady drop in the lake from the 8100 feet (2470 meters) level to its present level. The major vegetation zone in the survey area is pinyon-juniper. Shrubs and grasses form a sparse understory with blackbrush, Mormon tea, yucca, rabbit brush, and prickly pear being the dominant species. In spite of the elevation, Paradise Valley falls at the upper limits of the Arid Transitional ecozone because of soil and water conditions. Located on the eastern flank of the plateau, it receives less precipitation than similar elevations on the western or central areas.

Of the 198 sites located in the 1978 survey, 113 are above 8000 feet. In Paradise Valley the majority of sites occur at the 8100 feet level along the ancient shoreline of the lake. The sites located were classified on the basis of the kinds and quantities of artifacts located.

Eight classes were defined as follows: lithic scatter (148 sites), rockshelter (16 sites), temporary (15 sites), kill-butchering (12 sites), extended camp (8

sites), hunting (8 sites), quarry (3 sites), and granary (1 site).

The lake area shows a high proportion of extended camps compared to other areas covered by the survey. It is clear that the resources offered by the marsh and lake environment were exceptionally attractive to prehistoric populations. Collections from 97 of the 198 sites were made and included diagnostic pottery and projectile points. The majority of the pottery is Fremont in origin (A.D. 700-1100), but examples of Pueblo II pottery of Kayenta style and Shoshonean plainware were also found.

Seventy-six projectile points were recovered, a third of which were too fragmentary to classify. The remaining examples represent Archaic, Fremont, and Shoshonean point types. Although the illustrated points generate some questions as to the author's identifications, it remains clear that nearly 72 percent are Archaic types with Gypsum and Elko types having the largest representation. Fremont-Anasazi style projectile points represent 24 percent of the total, which closely agrees with the 22 percent of the total sites found with Fremont-Anasazi ceramics. In their summary, however, there is a tendency for the authors to associate point styles that they call Archaic (Elko and Gypsum) with Fremont occupation. As a result, they identify 57 percent of the occupations as Fremont. This tendency to blur Archaic-Fremont types does not seem supportable given data from excavations in the area which strongly suggest a distinct break between late Archaic and Fremont occupations.

One major item missing from this survey is the discussion of ground stone artifacts. A significant part of Hunt's treatment was the inference of subsistance based on abundant examples of metates and manos in mountain sites. The absence of discussion of ground stone from Paradise Valley seriously hampers such extrapolation. The authors note that such artifacts were found and recorded on site forms, but since the site forms were not part of the report, these data are unavailable. What is clear, however, is the abundance of prehistoric sites around the basin, particularly during the Archaic period. The attraction offered by the lake shore environment was obviously important in later Fremont times as well, as evidenced by the presence of ceramics at several sites.

Some of the sites in the vicinity of Paradise Valley have been shown to hold great potential for providing chronological and environmental data on the sequence of occupation. Vandalism to one area in 1979 revealed over a meter of stratified deposit ranging from early Archaic to Shoshone periods. Projectile points removed included types found at Joe's Valley Alcove (DeBloois, Green, and Wylie n.d.) and dated 8200-6200 B.P. Fremont and Shoshone ceramics came from the upper levels of the spoil dirt. A deep arroyo that cuts through the site has exposed artifacts and hearths buried up to two meters and more. Excavation at the site is currently being planned due to the pothunting activity that has been occurring. Two separate incidents in 1979 and 1980 have resulted in fines being assessed for digging in the area.

Long Park Reservoir

Long Park is a sage and grass covered basin on the north flank of the Uinta Mountains about 15 miles (24 km) northwest of Manila, Utah. The valley is formed by one of a series of sandstone and quartzite ridges that form the northern flank of the range. The east-west trending ridges form a series of narrow valleys which are drained through periodic breaks in the ridges. Long Park occurs at the head of one of these breaks, Sols Canyon, which descends rapidly to the north and thence to the Green River. The valley is at an elevation of 8600 feet (2620 meters) and is surrounded by forests of lodgepole pine and aspen.

Small streams flow through the valley from the south and east meeting at the northwest end of the park before tumbling down Sols Canyon. The work was precipitated by a proposed dam at the outlet of Long Park to create a small 300 acre reservoir with a pool elevation of 8607 and 8645 feet (2623 and 2635 meters) at minimum and maximum elevations.

The initial survey of the proposed reservoir was carried out by Berry (1975). Three lithic scatters were identified, each covering an area of several hundred square meters. The majority of the materials observed and collected consisted of quartzite flakes. Some fine-grained chert flakes were also present. Two tools were

recovered, a corner-notched projectile point of rather dubious association with Uinta-Fremont at 1500-1000 B.P., and a triangular chert biface. Although none of the recovered materials were of particular significance, the location of the sites was important. Few sites have been reported for the Uinta Mountains and fewer have received any archeological attention.

Unfortunately, testing for soil stability had greatly disturbed two of the three site areas prior to the survey. At one site, an excavation measuring 100 by 100 meters had been made by a dozer to obtain materials for a test embankment. As a result of the recommendations by Berry, test excavations were carried out by the Forest Service in November 1975 (DeBloois 1976). Trenching of all three site areas was conducted to determine depth and extent of the lithic scatters. Only one of the areas (42 Da 45) yielded evidence for buried cultural materials; unfortunately, this was the most disturbed of the three.

Cultural materials recovered included corner-notched projectile points and bifaces of chert and quartzite. No diagnostic materials were found in the test trenches and most of the tools came from backdirt of the embankment tests. No further work could be carried out during 1975 due to the lateness of the season but a recommendation for additional work at 42 Da 45 was made in hopes of recovering dateable or diagnostic materials from the deposit.

Additional artifacts were collected from the surface of the site in June 1976 by the District Ranger. These include three projectile points, biface, and three large bifacial preforms similar to Stage two blanks from Pine Spring (Sharrock 1966). The projectile points include a corner-notched Uinta-Fremont style, a stemmed point with serrated edges, and a broken point tip.

Finally in August 1976, intensive surface collections were made along with test excavations in additional locations. A fire hearth 1.3 miles long was located 20 cm below the surface at the edge of a previously disturbed area. Built in a basin-shaped depression, the hearth contained charcoal, ash, and quartzite flakes. A date of 1260 ± 100 B.P. (RL-778) was obtained. Other charcoal and ash lenses were observed in the backdirt of the embankment testing area but samples were not collected since they were not _in situ_.

Additional artifacts were recovered, including Desert side-notched and Rose Spring corner-notched projectile points. Several parallel-sided Humboldt projectile point bases were also found. Also included was a single Pinto style point. Several large bifacial knives were collected including a finely-flaked, but broken, parallel-sided biface that may be an Agate Basin-Angostura point.

A total of 1675 pieces of chipped stone were collected, 1573 of which were debitage, most of quartzite. The most numerous tool group included 43 bifaces and fragments. Several unifacial flakes were also found. Seventy-eight percent of the material was tan colored quartzite, and 21 percent chert, with rare examples of obsidian completing the final one percent. Two small cobble manos and a battered cobble hammerstone completed the inventory.

The single date of _ca._ A.D. 690 fits well with the most frequently occurring corner-notched points of Fremont origin. Large corner-notched and stemmed points suggest a middle Archaic use as well. One Desert side-notched point is suggestive of late prehistoric Numic use. Utilization of the area involved hunting (projectile points, drills, scrapers), seed processing (manos), and tool manufacturing (debitage of medium to small flakes, absence of cores).

Long Park supports the concept of continuing utilization of high altitudes from Archaic to Shoshonean times and gives us a rare radiocarbon date for some of that activity. It presents us with additional data about this occupation. Although remains of at least five hearths were found, only one remained sufficiently _in situ_ to be useful. A close examination of the area above the remaining hearth showed no visible sign of the buried hearth. The other remains were scattered over a 90,000 square feet (8360 square meters) area. To locate hearths lacking surface evidence would require an equal amount of perservance and good luck. Although nearly 600 feet (183 meters) of trenching was done, only a single hearth was located. The shallowness of soils on the sites greatly limits the stratigraphic potential. It

also suggests that buried hearths may be another feature of these high altitude sites that surface survey will rarely, if ever, locate.

Long Flat Site (42 IN 330)

Long Flat contains an exceptionally large lithic scatter on the Markagunt Plateau at an elevation of 10,000 to 10,200 feet (3050-3110 meters). Four outcroppings of chert form the focus for the scatter of primary and secondary flakes over an area nearly a mile long and one half a mile wide (1.61 by 0.80 km). Most of the material occurs in open meadows surrounded by spruce-fir forest. Permanent streams flow nearby. The material utilized is a homogeneous white chert, examples of which show up on many of the sites of the Markagunt Pleateau. Most of the artifacts reflect the extensive quarrying activity that has occurred over the centuries. Cores, primary and secondary flakes, core shatter, and both broken and complete blanks and preforms are present. A few finished tools indicate the exploitation of plant and animal resources as a secondary activity. Projectiles include gypsum points.

A major quarry site like Long Flat likely supported dozens of satellite workshops along access routes to and from the quarry. As the percussion formed blanks produced at the quarry were reduced to tools for hunting, different site assemblages were created, assemblages that are not found at Long Flat, but that are found at other locations on the Plateau. Sites containing only secondary and tertiary flakes and finished tools would have been linked to major quarrying centers.

Aspen-Cloud Rockshelters

Two small rockshelters were accidentially discovered during the summer of 1979, at the head of Saleratus Canyon on the Fishlake National Forest (Schley 1978). The shelters occur in a sandstone formation at the rim of the canyon a few hundred meters from its head. Located on the south-facing wall, Cloud Shelter is directly above Aspen Shelter and measures 10 meters wide by 4 meters deep and 2 meters high. Aspen Shelter, 40 feet (12 meters) below, measures 11 meters wide, 7 meters deep and 3 meters high. Both shelters are partially the result of water action as they occur in a small side drainage that carries water intermittently. Both shelters had been disturbed by pothunting. Artifacts recovered from the surface of spoil piles included quantities of animal bone, chert flakes, and plain gray pottery.

The lowest of the two shelters and the most important, Aspen Shelter is 8140 feet (2480 meters) above sea level and 80 feet (24 meters) above the floor of Saleratus Canyon. The entrance to the shelter is concealed by a heavy stand of aspen watered by a small spring that runs out of the eastern end of the shelter. A larger spring flows into a stock pond ambitiously called Saleratus Reservoir, 300 meters east of the shelter. The opposite side of the canyon is covered with Ponderosa pine while the canyon floor is open, grass meadowland.

West of the shelters lies the rolling surface of the Gunnison Plateau, while to the east Saleratus Canyon descends rapidly to the San Rafael Desert. The canyon acts as a natural corridor from the lowlands to the high country of the Gunnison Plateau.

These shelters are strategically placed and their potential was immediately recognized. Test excavations were carried out during the summer of 1979 to determine the amount of pothunting disturbance and to explore the depth and content of the deposits. Two 2 by 2 meter test pits were excavated in Aspen Shelter, one in each end of the shelter. A collection of surface artifacts was made after gridding off the entire shelter floor. Potholes were plotted and backdirt was removed to reveal any undisturbed deposits. In several locations nearly a meter of undisturbed cultural deposit remained over the bedrock floor. In the eastern end a meter and a half of deposit was sectioned and pollen samples were taken from the exposed column.

Unfortunately, more than 60 percent of the shelter had been extensively damaged by pothunting. In the few locations remaining, a meter of deposit contains abundant mammal bone, charcoal and ash, bone tools, a few stone flakes, and projectile points. Pottery occurs in the upper level of the deposit along with small corner-notched points. The base of the cultural deposit yielded gypsum points in association with a C-14 date of 4270 B.P. ± 210 (RL-1240). Identification of the faunal remains is currently being completed as is the analysis of the pollen samples.

From the preliminary results it is apparent that utilization of the uplands of the Plateau has occurred for nearly 4500 years. Where stratified deposits can be found, they can provide important chronological information that is useful in segregating the numerous small surface sites of the area.

Aspen shelter is a highly important site for the potential it offers. The activities represented in the test data indicate a strong orientation to food gathering, particularly hunting, but including the processing of plant foods. The relative abundance of bone and the paucity of lithic waste suggests the use of the shelter as a temporary base camp for hunting and gathering forays with limited retouching and sharpening of hunting implements being carried out. This is in contrast to many of the high-altitude open sites that contain high frequencies of lithic debris.

One is, of course, constantly nagged by the question of preservation in this context. Is the distinction between the contents of shelters versus open sites real or is it a matter of concentration of activities in a defined space over time with enhanced preservation of organic remains offered by the rock shelter? A good, stratified site in the open is needed to provide the data to answer this question. Such sites are extremely rare, however.

Cloud Shelter was also examined in 1979, but it did not receive any further testing. The deposits are very shallow and cultural materials are limited. Pothunting disturbance is extensive due to the shallowness of the deposit, but few artifacts were encountered. Cloud Shelter also receives considerable moisture from any runoff down the side drainage; Aspen Shelter, in contrast, boasts a considerable area that remains dry even during heavy runoff.

Lowder Creek Bog Site

This site was located in 1978 during an examination of a proposed peat mining operation. Although the major significance of the site is the peat bog and its potential for yielding paleoclimatic data, lithic artifacts were recovered from the area surrounding the bog as well. Coring of the bog proceeded simultaneously with the testing of the archeological site under a joint agreement between the Forest Service and the Utah State Antiquities Section (Sargent 1979). Results from the paleoclimatic studies have not been received at the time of this writing, but cores of considerable length were successfully obtained during the summer of 1979.

Lowder Creek is a small tributary of Mammoth Creek which drains much of the central portion of the Markagunt Plateau. The plateau runs southwest to northeast and is the westernmost of the High Plateaus of the Colorado Plateau Physiographic Province. The highest point on the Markagunt Plateau (11,200 feet/3414 meters) lies several miles north of Lowder Creek, near the western rim of the plateau. The site is located in the conifer-aspen vegetation zone and, more specifically, in the alpine fir-Englemann spruce community.

The bog is oval in shape, and measures 300 miles north-south and 160 meters east-west. Located in a small cirque basin, the bog forms the head of Lowder Creek. Artifacts were found in the preliminary survey scattered along the east, north, and northwest sides of the bog. The south and west sides of the basin are steep-sided, high ridges.

Test excavations were carried out on the east side of the bog in a 75 meters by 50 meters area of densest concentration of the lithic materials. Two small test pits were excavated, neither of which showed cultural materials below the 20 cm thick soil layer. Stone materials recovered included "core shatter" (amorphous chunks), primary flakes (with attached cortex), secondary flakes, bifacially flaked preforms or blanks, hammerstones, and retouched flakes. Finished tools were rare, and the only projectile point was of obsidian from a source 50 miles (80 kilometers) to the northwest. In addition to the cultural debris, unmodified cobbles of chert occurred in quantity over the area.

The Lowder Creek Bog site was utilized for quarrying and tool manufacturing from locally occurring stone sources. The single diagnostic tool, an Elko corner-notched projectile point, suggests an Archaic utilization of the site, although similar points are not unusual in Fremont contexts. Interpretations of the site contents are hampered, as they are in numerous other situations, by the small

sample of materials (223 items), the rarity of diagnostic artifacts, the absence of stratified deposits, and the lack of dateable materials.

Survey and Test Excavation in the Fishlake National Forest

A more systematic approach to high-altitude sites is that used by Simms (1979) in the investigation of 11 Forest Service projects in south-central Utah. Three of the projects are below 8000 feet while the remaining eight range from 8000 to 11,300 feet. Nine sites were located, all but one above 8000 feet.

These sites are described as lithic scatters of small to large size containing flakes of cherts and occasional obsidian. Tools are limited to utilized flakes, scrapers, bifaces, projectile points, metates, and manos. These tools are not common to all the sites but range in frequency of occurrence in the same order as listed.

Diagnostic projectile points include Elko corner-notched, Sudden Shelter side-notched and Bull Creek. These represent middle Archaic and Anasazi period utilization. Metates and/or manos are reported from four of the sites, three from over 8000 feet. These are both slab and oval basin metates with limited wear. One site, 42 SV 1357, was the subject of more intense examination including surface mapping and collecting, test excavation, and artifact analysis.

The site was mapped using a 1-meter grid and all concentrations of lithic debris, tools, and other significant features were plotted. Contour maps were made showing artifact densities per square meter along with tool locations. Three exploratory test excavations were carried out in three of the nine concentrations of artifacts that make up the site. Both natural and arbitrary stratigraphic levels were used to control the excavations. Two soil units were described, the uppermost a brownish-gray to buff-colored silty, sandy deposit of medium compaction. This unit appeared to be the result of Holocene colluvial processes combined with aeolian silt deposits.

The lower soil unit is reddish-brown clay loam of hard compaction, possibly associated with terminal Pleistocene permafrost conditions. This soil unit occurs 30 cm or more below the surface. All cultural materials came from the surface or within the upper soil unit. Most of the artifacts were within 10 cm of the surface, with a few located from 10 to 20 cm deep. A single hearth that produced a date of 90 $\pm$ 175 B.P. was found beneath a slap mētate (Simms 1979:50).

Projectile points recovered included a side-notched point of either Sudden Shelter side-notched or San Rafael side-notched style (6500-4800 B.P. and 4700-3800 B.P. respectively), two gypsum points (4500-1500 B.P.) and a Desert side-notched point (1000-2000 B.P.). The associated time spans for the projectile point styles suggests a gap from Archaic to Numic periods for this occupation; however, given the small number of artifacts recovered, this argument is extremely weak. Obsidian samples submitted for analysis came from two different sources in the Mineral Mountains of western Utah, sources that were heavily utilized from the Archaic to historic period.

Simms (1979) suggests that access to highlands was along certain corridors and that sites were utilized for a few days or weeks each summer over a long period of time. Although the concentrations of artifacts were defined, there appeared to be little discernable segregation of tool types or assemblages. Concentrations with metates showed no distinction in the distribution of artifact types from concentrations without ground stone. Simms confirms Hunt's (1953) point that ground stone is an important part of the high-altitude site assemblage.

Although many of Simms' conclusions are confirmations of previously held assumptions, he does add to our knowledge of high-altitude sites. He confirms the fact that most of these sites contain limited stratigraphic context, limited numbers of artifacts, and limited quantities of diagnostic tool types or dateable samples. He appears to have missed the opportunity to try obsidian hydration dating even though he uses source identification techniques, but then he is not alone in this. Obsidian is relatively abundant in high-altitude sites in western Utah, decreasing in quantities as one moves east. More utilization of hydration dating to establish relative and absolute

chronologies would greatly aid our efforts to control time in these sites. A project to carry out hydration dating of several hundred projectile points from the Pine Valley Mountains by the Forest Service was initiated but never completed. That study needs to be resurrected.

Joe's Valley Alcove

Salvage excavations carried out at Joe's Valley Alcove on the Manti-LaSal National Forest since 1973 are of significance to the matter of high-altitude adaptations. Although the alcove is located at 7000 feet (2130 meters) above sea level, it contains stratified cultural remains that pertain to middle to late Archaic and Fremont occupations of central Utah.

The shelter is formed in Castlegate sandstone at the juncture of this formation and the underlying Black Hawk shales. Two occupational sequences were present in the alcove separated by a stratum of sand and roof fall. The lower occupation occurred directly on the shale floor of the small shelter some centuries prior to 8210 ± 220 B.P. and continued until shortly after 6200 ± 190 B.P. There followed a period of abandonment marked by a large block of roof fall and sand deposits which were culturally sterile except for a single hearth dated to 3520 ± 200 B.P. Reoccupation of the shelter occurred about 2460 ± 120 B.P. and continued again until 930 ± 100 B.P.

Although the numbers of artifacts recovered were limited due to the small size of the shelter, and the presence of considerable moisture has resulted in poor preservation of all but the very uppermost deposits, much useful data have been obtained. One hundred forty-nine tools were recovered, along with over 2000 waste flakes, 187 wild and domestic plant remains representing 95 different species, 4300 animal bone pieces, and 42 corn cobs. Twelve radiocarbon dates were obtained spanning the entire sequence of occupation. Palynological samples were also taken from the deposits.

Included in the collection of stone tools are 56 projectile points. The largest group of classifiable points is called Stemmed Indented-base and exhibits a clear distribution from 8200 to 6200 B.P. Elsewhere called Elko Split-stemmed (Aikens 1970), these 17 points are statistically matched most closely to Pinto Shouldered points from Sudden Shelter (Holmer 1979; Jennings, Schroedl, and Holmer 1980).

The second major group of points is the Elko corner-notched which demonstrates a distribution in increasing numbers that begins about 7600 B.P. and continues to the end of the Archaic use of the shelter at 6200 B.P. Statistically these are most closely related to Elko corner-notched points from Danger Cave (Holmer 1979), with the collection from Sudden Shelter being a close second in similarity.

A third class of points, Elko side-notched, are distributed in a similar fashion to the corner-notched points and show a close metric relationship to Sudden Shelter side-notched points. Although these and the Elko corner-notched points appear to overlap Archaic and Fremont periods, no such points were found in Joe's Valley Fremont deposits. No good examples of Fremont point styles were recovered from the alcove either. Unfortunately the artifacts from the critical transitional Archaic to Fremont deposits are extremely nondescript and attest to occasional and sporadic use of the shelter. The absence of classic point types is suggestive but not conclusive evidence for a major decline in aboriginal use of the area and a break between Archaic and Fremont occupations.

The plant remains recovered attest to a broad range of exploitation of local resources. These remains, although all from the upper portion of the deposit (Fremont), are similar to Fremont and Archaic patterns from other sites in Utah. What is striking to one participating in the excavation is the abrupt disappearance of all plant remains except pollen and microfossils at the caliche line in the middle of the upper cultural deposit.

Everything below this line is seasonally subjected to moisture from the Black Hawk shale-Castlegate sandstone junction. Only the most resistant organic remains are preserved in the Archaic deposits. It would be logical to assume that a similar depletion of organic remains due to exposure occurs in all surface sites. The comparison of a wet Archaic site like Joe's Valley with a dry site of the same period could be highly revealing in quantifying the effects of preservation, or the lack of

it, on recoverable items.

Of the 506 identifiable animal bones, 207, representing 48 individuals, came from the lower occupation. From the upper occupation 228 pieces of bone represent 69 individuals. This evidence suggests that the most important animals to the Archaic hunters were the bighorn sheep (Ovis canadensis Shaw), the mule deer (Odocoileus hemionus Rafineque), and the porcupine (Erthizon dorsatum expixanthum Brandt). Sheep where apparently hunted close to the site with most of the carcass being transported to the shelter. Deer were killed farther from the site and selected portions were returned to camp. Porcupine were brought to the site whole and cooked judging from the proportions of burned bones. Although the same animals remained important in later Fremont occupations, bison (Bison bison bison linnaeus) remains appeared and an increasing number and variety of small mammals were hunted, including jackrabbit, cottontail, marmot, and prairie dog.

Domesticated plants (corn and squash) also appeared in the Fremont period. The corn is represented by cobs, kernels, shucks, stock and root fragments and seems to have been locally grown in spite of the elevation. It is possible that the alcove functioned as a field house during the Fremont period.

Panguitch Lake

In October 1974, an examination (Dunbar 1974) of an 80 acre parcel of land west and south of Panguitch Lake proposed for exchange revealed four lithic concentrations scattered around an outcropping of white chert. The site lies at 8300 feet (2530 meters) at the western end of a small basin on the Markagunt Plateau. Panguitch Lake fills most of the eastern end of the valley. The surrounding ridges reach 9000 to 10,000 feet (2740-3050 meters above sea level and are covered with pine and aspen forest. The lower valley is open, and sagebrush covered with scattered clumps of pine and aspen. At the western end of the lake there is considerable grassland and marshland.

A popular resort and fishing spot, considerable impact has occurred from recreational collecting over the years as a number of local residents will attest. Many fine "arrowhead" collections have been enhanced by examples from Panguitch Lake. Historical documents record the location as a winter encampment for Numic peoples from western Utah (Kelly 1964). As snows melted in the higher elevations, the Paiute would range higher and higher onto the plateau until early fall. If the pinenut crop was adequate, they would then move to lower elevations for the harvest, returning to the high plateau for a few more weeks of hunting before snow fall.

Although this cycle of activity is based upon long tradition in the Great Basin, the utilization of Panguitch Lake as a winter base camp seems rather unlikely. Snowfall at this elevation is considerable, exceeding 100 inches (254 cm) in depth during most winters. Other Paiute bands followed a similar pattern but wintered at much lower elevations in western Utah valleys. Other historical accounts mention Indian groups exploiting similar high mountain valleys and the surrounding mountain environment (Gottfriedson 1919), wintering in valleys such as Koosharem, not much lower than Panguitch Lake.

Although most historical accounts do not provide much detail as to Paiute subsistance patterns in these high valleys, Panguitch Lake is specifically mentioned as an important fishing spot.

The sites identified in 1974 are located at the transition from pine-aspen forest to sagebrush cover along the lower slopes. Although lithic debris can be found along the entire southern shore of the lake, the project requirements limited the examination to 80 acres at the western end of the lake. Of particular importance to the immediate site area was the occurrence of two outcroppings of gray-white chert. Originally identified as a quarry and workshop complex (Dunbar 1974), the sites possessed considerable amounts of white chert in various stages of reduction from rawchunks to blanks and preforms.

Additional evaluation of the site centered on a sampling of the extensive lithic scatter with intensive surface collection. Two separate sampling areas were selected and marked in a 10-meter square grid. Various sampling strategies were then employed to select squares for collection. Each square selected was carefully examined and all surface artifacts were collected.

Nearly 5000 items were collected from the two grids. Although the majority of items were the products of lithic reduction, other items supported an interpretation of the use of the area for other activities. Projectile points and fragments, metate and mano fragments, and burned river cobbles suggest the use of the area for subsistence activities. Most of the artifacts recovered, other than the quarrying debris, represent materials imported from other sources, such as obsidian, sandstone, basalt, and clay. None of the finished tools were fashioned from the locally occurring white chert. Although it is difficult to assess the impact of surface collecting on the site over the years, local informants tell of considerable quantities of arrowheads being removed from the site. It is unlikely that only points of local chert were removed leaving only points made of foreign materials. It is possible that quarrying and subsistence activities were carried out separately on the site, either at different seasons, or by different peoples, or at different time periods.

In an attempt to discern spatial relationships and patterning in the surface collections, contour plots of various categories of artifacts were made using frequencies as the contour values. The resulting plots suggest that the quarrying of raw stone and the removal of primary flakes occurred in the immediate vicinity of the stone source. Secondary flakes were found in separate "islands" scattered across the site, suggesting distinct loci of secondary reduction activity. Plots of white chert flakes and foreign red chert flakes revealed distinct distributions that led to the discovery of a quarry site of red chert a short distance outside of the study area.

Ceramics, projectile point fragments, and ground stone clustered at opposite ends of the study grids from the quarrying remains. Subsistence activities were taking place closer to the lake and lower down the slope than the procurement and reduction of chert.

Although any conclusions must be tempered by the obvious impact of collectors, the method employed in examining this extensive lithic scatter shows some promise of being able to distinguish spatial patterning. The difficulty with applying this technique to most high-altitude lithic scatters is the small number of items present and the low densities of diagnostic artifacts.

RESULTS OF HIGH-ALTITUDE SURVEY PROJECTS

Beginning in 1970 and continuing annually to the present, an ever increasing number of small Forest Service projects have been subjected to archeological survey. These projects include timber sales, road construction, land exchanges, water developments, and recreational developments. Many of these projects occur at elevations above 8000. Files of archeological sites located during these projects have grown significantly over the last 10 years in the Intermountain Region of the Forest Service. In an attempt to review the amount of information available for high-altitude sites, site forms for all sites above 8000 feet on the Dixie, Fishlake, and Manti-LaSal National Forests were compiled. These three forests are all located in southern Utah and border on the Southwestern Culture Area.

Nearly 500 sites have been located on these three Forests in the past decade at or above the elevation specified. Due to difficulties caused by a change in residence and assignment of the author, and the unexpectedly large number of sites, only 336 sites were considered for this chapter. Each site was summarized briefly in terms of elevation, topographical location, vegetation zone in which the site occurs, type of site, categories of artifacts found, and diagnostic items.

Sites range from 8000 feet up to a maximum of 11,000 feet above sea level, with a mean elevation of 8610 feet (2624 meters). There is obvious clustering of sites at the lower elevations with a gradual decrease in site numbers as elevation increases. Although there is undoubtedly a certain amount of bias in this group of sites, this pattern reoccurs in each of the three Forests examined. The single exception is a clustering of 26 sites at the 10,400 feet (3170 meters) level of the Dixie National Forest. This compares with 46 sites between 8000 and 8400 feet (2440-2560 meters) and 19 sites between 8400 and 8800 feet (2560-2680 meters). Although this clustering may be the result of the availability of a vast expanse of area at the elevation on the Markagunt Plateau, it still represents the use of high elevations at a frequency greater than other

areas.

The type of site most often encountered is described as a lithic scatter (86 percent), with scatters of ceramics and lithics representing only a very few cases (8 percent). Sites with features such as rock alignments or hearths represent 4.8 percent, with less than 1 percent of the sites being ceramic scatters with no lithics. A total of 316 (94 percent) of the sites are described as having no observable subsurface component. The most popular locations for sites include slopes, ridges, mesas, valley bottoms, and saddles. These locations represent percentages ranging from 27.7 to 6.8 respectively.

Ceramics are found on 13 percent of all sites and include Fremont, Anasazi, and Shoshone varieties in that order of frequency. Ground stone, including metates, manos, milling stones, and axes, is rare, being found on only seven percent of all sites. The most common forms are slab and basin metates (called Utah-type) and one-hand manos and milling stones. Projectile points were recovered from 30 percent of all sites but less than a third of these were classifiable or were classified. Of the handful of point styles identified, Elko corner-notched, Elko side-notched, and Rose Spring corner-notched are the most common. The first two styles are found in middle to late Archaic contexts (5600-500 B.C.), while the last is more characteristic of early Fremont sites (A.D. 650-900). The smattering of other point styles extend the time representation to later Fremont and Anasazi periods (A.D. 900-1200), and to Numic times (A.D. 1300-1800). Examples of early Archaic types (6200-5200 B.C.) are represented by Humboldt and Pinto style points. Although no PaleoIndian points have yet been found in Forest Service surveys in this altitude range, Clovis fluted points have been reported by collectors from some of these areas.

It is clear that surveyors have been reluctant to specultate on the cultural affiliation of most of the sites located. Fully 72 percent of the sites are listed as of unknown cultural affiliation. Thirteen percent are classified on the basis of ceramic content, while the rest depend upon projectile point types for their cultural identifications.

Outside of the Manti-LaSal National Forest, Archaic sites are the most frequent class of sites identified (45 percent). Fremont sites are next in frequency with 25 percent of the total. Twelve and one-half percent of the sites contain both Archaic and Fremont projectile point styles. Only two Shoshone-Paiute sites (3.6 percent) were identified in the total sample. The Manti-LaSal National Forest sample contained 38 Anasazi sites ranging from Basketmaker III to Pueblo II periods based upon ceramics. Nine of these included small masonry rooms similar to the field houses on Milk Ranch Point (DeBloois and Green 1978). A higher frequency of ground stone implements was found on sites from the Manti-LaSal National Forest (12.4 percent) than on sites from the Dixie and Fishlake National Forests (5.3 percent). On the other hand, projectile points are more frequent on Dixie and Fishlake sites (33.7 percent) than on Manti-LaSal sites (21.3 percent). The similarities in high-altitude sites are greatest between the Dixie and Fishlake samples while the Manti-LaSal sample includes the upper range of Anasazi habitation sites with their ceramics and ground stone artifacts perhaps accounts for the distinction in the frequencies of projectile points and ground stone between these areas.

CONCLUSIONS

The results of 10 years of survey in high altitudes includes the identification of nearly 500 sites from southern Utah Forests. Although these sites are overwhelmingly similar in their lack of depth, diagnostic materials, and density of artifacts, they do verify the use of altitudes of up to 11,200 feet (3415 meters) in the prehistoric past.

Three possible models of past use can be considered:

1) Entire groups moved up into higher elevations on a seasonal basis to exploit a variety of plant and animal resources.

2) Seasonal exploitation of highland resources was carried out by segments of a lowland population.

3) Highland areas were occupied and utilized on a permanent basis by populations distinct from those at lower elevations.

Historical evidence supports both of the first two models. Numic populations of the eastern Great Basin ranged widely from winter villages in the pinyon-juniper forest of the lower mountain slopes and foothills. Small bands ranged from the valley bottom to the high mountains in search of a wide variety of resources. At time the groups moved intact as villages, while on other occasions individuals or small parties sought special resources such as deer.

Historical records indicate that some Southern Paiute groups followed a seasonal round that started and ended at much higher elevations than their Great Basin neighbors. Panguitch Lake, at the northern end of the Markagunt Plateau, and Koosharem, at the foot of the Fishlake Mountains, are two locations identified as the winter villages of Paiute groups. From these high mountain valleys, the groups would range upward as snows melted in the spring and summer in the higher elevations of the Markagunt and Fishlake plateaus.

Only in the Elk Ridge area does there exist a suggestion of sedentary habitation above the 8000 feet level. Here at the transition of the serviceberry-oak brushland and ponderosa forest zones, a few sites with masonry rooms are found. They are small one and two room constructions, their use year-round remains questionable, however.

Although postulating historic patterns of use into the prehistoric past is tempting, there are several problems to overcome. Tracing the entire seasonal round for Numic populations has not been particularly successful. Even examining known historic Paiute winter village locations has failed to provide clear evidence of what they might look like archeologically. The only generally acceptable diagnostic artifacts, Desert side-notched points and Shoshone pottery, are far too rare to clearly define the full range of site possibilities.

The proceeding Fremont phenomena is known almost exclusively from the relatively large, valley floor, agricultural village sites. Highland manifestations are suggested by the occurrence of Fremont pottery and projectile points. Generally the Fremont is seen as a Model 2 exploitation of highland environments. Lowland farming village subsistence was supplemented by resources gathered from highland environments. Tool assemblages would likely be different for highland sites given the specialized exploitation of highland environments. Lowland farming village subsistence was supplemented by resources gathered from highland environments. Tool assemblages would likely be different for highland sites given the specialized exploitative activities, with an emphasis on hunting and gathering implements. The ephemeral nature of most highland sites makes it extremely difficult to associate them with lowland Fremont expressions, however. Highland research is showing more and more Fremont habitation sites ranging far higher than previously known. Sites at 7000 feet (2130 meters) and higher are being located in the Fishlake National Forest, for example. One large site with 32 pithouse-granary complexes shows an A.D. 1000-1100 occupation. Earth ovens are found scattered throughout the area with radio carbon dates in the A.D. 650 range. Single pithouses have also been identified with occupation dates of A.D. 680-880.

What is unusual about these higher elevation Fremont sites is the increase in amounts of projectile points over lowland sites. A single pithouse, FL-181, has yielded more than a dozen (DeBloois n.d.). Early Fremont sites (A.D. 600-800) also rarely contain painted ceramics, in contrast to those from later occupations (A.D. 1000-1200).

Although the arguments still continue as to the degree of dependence placed by the Fremont upon agriculture, recent data supports an early Fremont occupation that was quite differently focused than that of the 11th and 12th centuries. It appears that a gradual shift from highland exploitation of wild plant and animal resources to a lowland, agriculturally based, village complex occurred through time with considerable variation from one region to another.

For the eastern Great Basin, there appears to be evidence for a gap in occupation between the late Archaic and early Fremont sites (Madsen and Berry 1975), this gap, from 500 B.C. to A.D. 500, roughly, presents another hurdle to the postulation of historical patterns for Archaic populations. Until the last decade, all Archaic data available from Utah came from cave sites around the Great Salt Lake Desert.

These data reveal a subsistence system based upon lake shore environments with considerable significance placed upon plant resources. Excavations in central and eastern Utah (Joe's Valley Alcove, Sudden Shelter, Cowboy Cave, Aspen Shelter) have begun to provide data from a much different environmental setting. Several of these sites are situated along natural corridors from lowland to highland areas; Aspen Shelter lies at the head of Saleratus Canyon, Sudden Shelter at the entrance to Salina Canyon, and Joe's Valley Alcove at the head of Straight Canyon. Except for Aspen Shelter, these sites are on major access routes to highland areas still in use today.

Archaic utilization of high altitudes is clearly supported by the evidence from the past decade of Forest Service activity, although the pattern of that utilization is somewhat cloudy. The frequency of Archaic projectile points found in highland settings cannot be explained by the curating of old points by more recent populations. If anything, a considerable number of Archaic points have already been removed from highland sites by the collectors of the region. The continuing discovery of Archaic deposits in stratified sites on the fringe of or in the highlands supports high elevation use from as early as 8200 B.P. Recently discovered stratified open sites such as in Paradise Valley on the Fishlake National Forest give the promise of furthering our understanding of prehistoric use from Archaic to Shoshonean times at the upper elevational extremes of these highlands.

PART FOUR: HIGH-ALTITUDE SITES IN COLORADO

SHELTERED HUNTER-GATHERERS AT A MODERATELY HIGH-ALTITUDE: AN INTERIM SUMMARY OF ARCHEOLOGY IN CURECANTI NATIONAL RECREATION AREA

James W. Mueller and Mark Stiger

INTRODUCTION

This chapter addresses adaptational and chronological issues of moderately high-altitude, hunter-gatherer archeology from an empirical perspective, which primarily includes excavated data from 13 sites within Curecanti National Recreation Area (NRA). Excavated materials, as well as contemporary distributions of plant and animal species, are used to generate a model of the paleoenvironment. This chapter provides both a preliminary summary of investigations through the 1979 field season (with selected impressions from subsequent seasons) and speculations concerning paleoenvironmental reconstruction and community patterns that may be useful in future investigations.

Curecanti NRA consists of three reservoirs and adjacent lands in the upper Gunnison River in the west central portion of intermontane Colorado (Figure 17). This reservoir system is being developed by the USDI Bureau of Reclamation to provide recreational facilities and hydroelectric power. The cultural and natural resources are being managed by the National Park Service as part of a multi-year program that will continue through 1984.

One hundred thirty-four archeological sites (Stiger 1977) are located within the boundaries of Curecanti, and include combinations of lithic scatters of various densities, ground stone, storage cysts, wickiup shelters, and hearths. The radiocarbon dates place the main occupation between ca. 10,000 and 2200 B.P. with limited evidence of earlier and later occupations. Particularly intensive occupations seem to have occurred at about 6000 B.P. and 4300 B.P., while there is an absence of dates from about 5000 B.P. to the middle of the fourth millenium B.P.

THE ENVIRONMENTAL BACKGROUND

Most of Curecanti lies within the broad, upper Gunnison Basin (Figure 18) which has an average elevation of 2286 meters. This basin is bounded on the north by the Elk Mountains which includes some peaks exceeding 4267 meters in elevation. To the south are the San Juan Mountains, including peaks higher than 4267 meters and to the east is the Continental Divide. The western boundary is a series of high mesas rising over 2743 meters. The Gunnison River runs east to west through the middle of the basin cutting the Black Canyon of the Gunnison through the high mesas toward Montrose, Colorado. This spectacular canyon is over 610 meters deep in places with many sheer cliffs. Aside from the Black Canyon, there is no way to enter the upper Gunnison Basin without attaining the minimum elevation of 2667 meters at Blue Mesa Pass. Soils across most of the area are shallow and mixed with weathering bedrock. A few local areas have alluvial deposits of unknown depth.

Curecanti lies between the towns of Gunnison to the east and Montrose to the west. The U.S. Weather Bureau for Montrose, at 1777 meters elevation, reports an average annual temperature of 9.72°C and 23 cm average annual precipitation. Gunnison, upstream from Curecanti NRA at 2345 meters elevation, is reported to average 27 cm of moisture annually with a 4.50°C average annual temperature (Woodbury, Durrant, and Flowers 1962:15). A late spring and early summer dry season is broken by midsummer to early fall thunderstorms. The greatest precipitation occurs in August (National Park Service 1976:16). The growing season is short (68 days), and the weather changes are frequently rapid and severe.

The biotic communities may be divided into three zones classified by topography: (1) streamside zones, (2) terrace zones, and (3) hillside, talus, and upland zones (Woodbury, Durrant, and Flowers 1962).

The plant communities of these zones differ

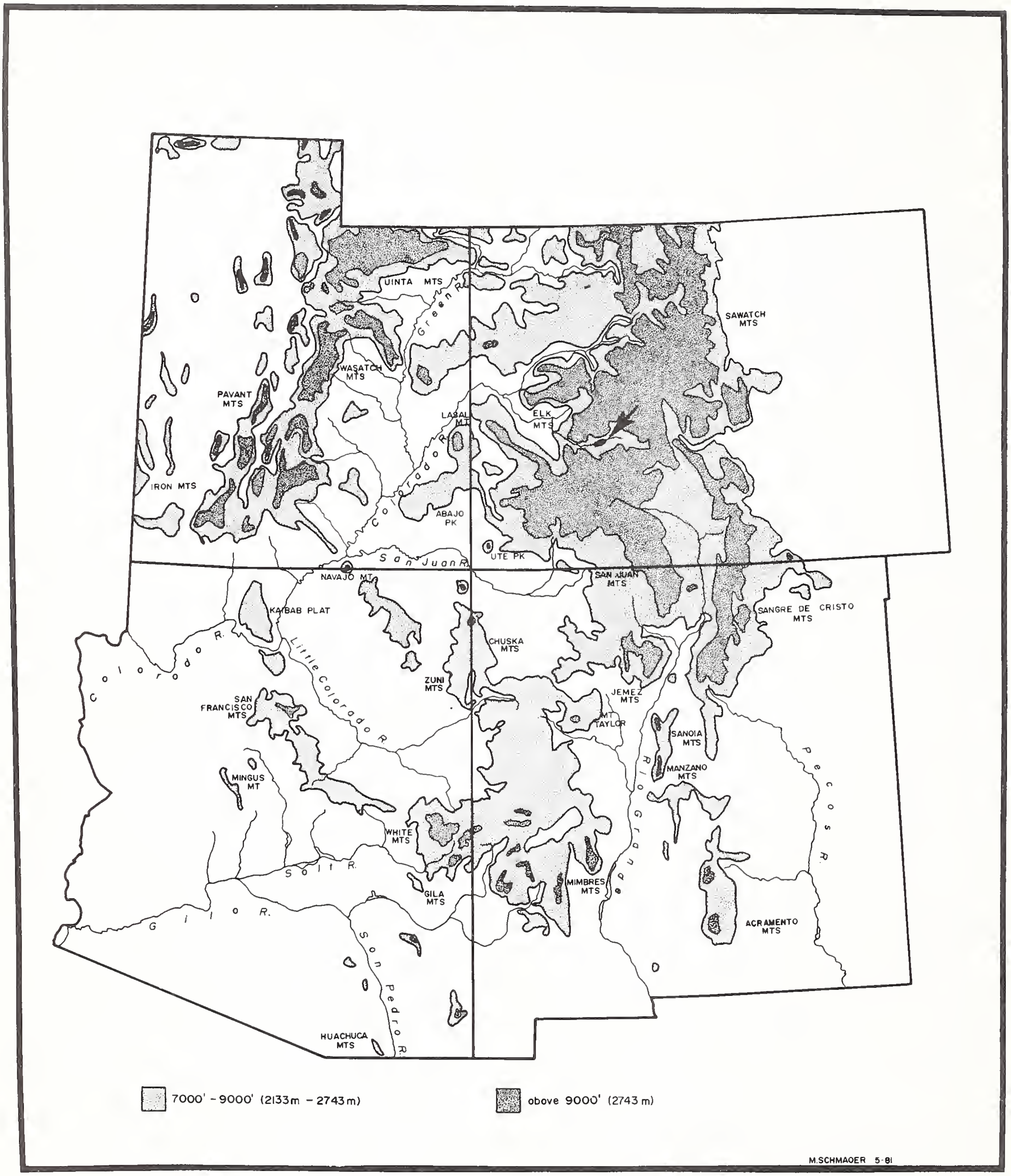

Figure 17. The Location of Curecanti National Recreation Area.

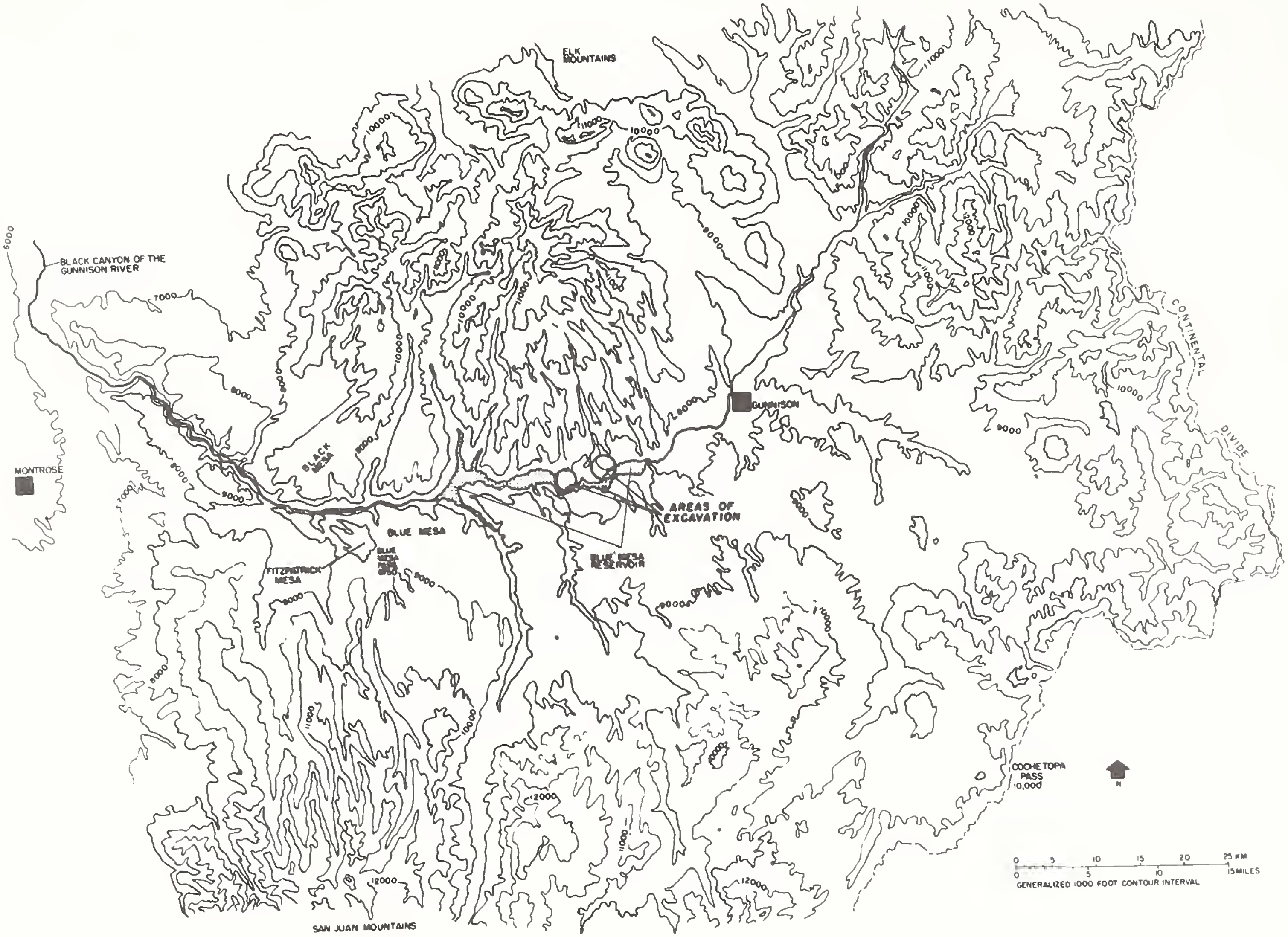

Figure 18. Map of Upper Gunnison Basin.

mainly through differential availability of water for plant growth. The streamside communities have generous soil moisture due to percolating water at levels near the ground surface. The terrace zones receive capillary soil moisture moving laterally from adjacent areas in addition to precipitation. The hillside, talus, and upland zones are dependent upon rain and snowfall with a small amount of runoff.

Streamside zones reflect the plentiful moisture and the effect of seasonally fluctuating water levels. Trees are predominately cottonwoods, although in the protected side canyons Douglas fir and blue spruce are present. A variable shrub understory is common, while a low herbaceous group of plants is found on the gravel bars and floodplains. The streamside zone includes the partially inundated floodplain of the Gunnison and its tributary streams.

The terrace zones are usually treeless, with occasional conifers. The most common plants are sagebrush, rabbitbrush, saltbush, and grasses. Occasionally a few herbs are found.

The hillside, talus, and upland zones are dominated by conifers, including mountain red juniper, blue spruce, ponderosa pine, and Douglas fir. Pinyon pine is not found in the area immediately surrounding the Blue Mesa Reservoir. Shrubs form an understory consisting of scrub oak, serviceberry, mountain mahogany, choke cherry, currants, rabbitbrush, and sage. Grasses and forbs are scattered throughout this zone.

The avifaunal resources are varied. Of the 165 species recorded in 1961 (Ibid), 71 are considered permanent inhabitants. Present species which may have been used aboriginally include ducks, hawks, eagles, falcons, grouse, ptarmigans, owls, and flickers. Mammals observed, collected, or reported represent 83 species. Included are cottontail, jackrabbit, elk, mule deer, mountain sheep, and 13 species of rodents. Historically, bison and pronghorn were also found in the area. The Gunnison River has been known as an excellent trout stream. While several species of fish have been recently introduced, the cutthroat is the only native fish in the area.

The Prehistoric Environmental Data

Excavations in Curecanti thus far have produced minor amounts of floral and faunal material. This appears to be due to the age of the sites related to the natural decay of organic material and to cultural practices, e.g., burning and fracturing of bone refuse. Only a few identifiable faunal remains have been found, including Rodentia sp., Neotoma cf. cinera, Cervus canadensis, and Ovis canadensis. All four taxa occur today in the study area.

Five hearths produced pinyon charcoal, while two produced ponderosa charcoal. The pinyon charcoal comes from hearths dated from 7890 to 4419 years B.P. The only other identified carbonized floral specimen is a single Barrel cactus seed (Echinocerus sp.). A species (E. coccineus) of this genus occurs in the area today.

Pollen evidently preserves poorly in Curecanti. Only two samples came from clearly cultural contexts. Both have higher pine pollen frequencies than a surface sample from the general area. A sample from a fire hearth produced a high percentage of prickly pear (Opuntia sp.) pollen (opuntia polycantha now grows in the area). Since Opuntia is an insect pollinated plant, the pollen probably is an indicator of cultural use. The hearth contained two charcoal layers separated by sterile fill. The pollen sample came from the lower charcoal layer, while the top layer produced a radiocarbon date of 5778 ± 560 B.P. The other well provenienced pollen sample came from the floor of a burned shelter which yielded three radiocarbon dates of about 4600 B.P.

SETTLEMENT PATTERNS AND SITE FUNCTION

We can define four different types of locations for the test excavated sites (Figure 19). The first is a ridgetop location where soils are generally shallow and bedrock is exposed in places; this location, which has only been test excavated, occurs on the north side of the Gunnison River. The second, lowland location, is off the ridgetop in deeper soil, generally on terraces above tributary streams on the north side of the Gunnison River. A comparable location on the south side of the Gunnison constitutes the third locational setting. The "lowland" description is relative in light of the fact that

the floodplain of the Gunnison River and adjacent portions of colluvial slopes are presently under Blue Mesa Reservoir. The fourth location is on the sloping sides of ridges where soil depth is variable. Some larger sites, e.g., 5GN10 and 5GN206 (average elevation, 2293 meters have areas in both northside ridgetop and lowland locations. However, it appears that there are functional differences in areas located in the different topographic situations, such as at site 5GN10 (average elevation: 2315 meters where 26 two by two meter test squares were excavated in the ridgetop areas D, E, and F. Five hearths, one cyst, several postholes, and pieces of adobe were found. The postholes and adobe appear to be remnants of habitation structures. Fifty-three bone fragments were also uncovered. Lithic artifacts are tabulated in Table 3.

Areas A and B of 5GN10 are located just above the floodplain of Willow Creek, in relatively deep soil in a "lowland" topographic situation at an elevation of 2298 meters. Ten two by two meter test squares were excavated and three hearths were found. One small bone fragment and no habitation structures were encountered.

The differences in the artifacts found on ridgetop and lowland occupations are obvious in Table 4. For example, the sheer numbers of lithic specimens found in the lowland occupations are much greater, and the major difference in composition between the assemblages is an approximate eleven fold increase in the ratio of ground stone to flaked stone on the ridgetop sites.

As shown in <u>in situ</u> chipping stations, and hearths, intervening sterile areas, and the nature of the local topography, it is obvious that the lowland sites are not the product of erosion washing lithics down from the ridgetop sites. Assemblage differences between site types probably reflect behavioral differences.

It appears that the ridgetop sites are places of habitation (structures), plant food processing (high ratio of ground stone), and animal food consumption or processing (frequent bone fragments). The lowland sites seem to be related to shorter term occupation (no structures), little consumption or disposal of animal food (rare bone), minor plant processing (low ratio of ground stone), and major emphasis on tool manufacture and maintenance (abundant lithic debris).

Two sites, 5GN191 (elevation 2289 meters) and 5GN212 (elevation 2301 meters) that have been investigated on the south side of the Gunnison River constitute the third locational type. Both sites are on north-facing downslopes and contain many slab-lined and unlined hearths (at least 87 hearths at 5GN191 and 30 at 5GN212). These two southside sites appear to represent a long-term reuse of two favorable locations. Occupation was probably temporary since no habitation structures were found. Some plant food processing is indicated by the presence of ground stone. Lithic tool manufacture and maintenance apparently was a major activity, while bone fragments indicate game processing and consumption.

The fourth site type found on the north side of the Gunnison River is represented by 5GN247 and 5GN204 (elevation 2318 meters; Euler and Stiger 1981). They appear to be trash dumps from the ridgetop habitation sites and contain bone, lithics, charcoal, and abundant amounts of fire-cracked rock. Although none have yet been extensively excavated, they would appear to be the best opportunity to study the subsistence remains from a ridgetop site. Large dumps such as 5GN247 (elevation 2286 meters) indicate an extended occupation or a long-term multiple reuse. The deposition of trash at these dump sites may account for the absence of large amounts of cultural refuse on ridgetop habitation sites.

The settlement pattern in Curecanti appears to be similar to that of the proto-historic Ute of western Colorado. Buckles, working 50 miles (80 kilometers) west on the Uncompahgre Plateau, test excavated several standing wickiup villages (Buckles 1971:627-659). These sites bear many similarities to the Curecanti ridgetop sites although all of the Uncompahgre wickiup villages are located in areas with pinyon pine. Structures consisted of poles set on the ground in tepee fashion. Flaked stone artifacts were rare and a few pieces of ground stone were found. Floors were generally poorly defined. Many pieces of highly fragmented bone were present. Because of the paucity of trash, Buckles speculated that the wickiups were not long-term habitations, or that trash may have been dumped off the site. It is

Table 3. A Comparison of the Lithic Assemblage from Ridgetop and Lowland Areas of 5GN10

A. Ridgetop Areas (D, E, F)

Artifact Category	Number	Percent of Total	Average No. per test pit
Debitage	913	92.41	35.12
Utilized Flakes	39	3.95	1.5
Preforms	4	.41	.15
Cores	3	.30	.12
Flaked Stone Artifacts	12	1.22	.46
Ground Stone Artifacts	17	1.72	.65
Total	988	100.01	38

B. Lowland Areas (A, B)

Artifact Category	Number	Percent of Total	Average No. per test pit
Debitage	3824	92.32	382.4
Utilized Flakes	239	5.77	23.9
Preforms	15	.36	1.5
Cores	2	.05	.2
Stone Artifacts	56	1.35	5.6
Ground Stone Artifacts	6	.15	.6
Total	4142	100.0	414.2

suggested that the Curecanti ridgetop sites represent an adaptation similar to that of the Uncompahgre sites.

Sites other than 5GN10 that are part of the ridgetop occupation are 5GN205 at an elevation of 2316 meters (discussed in detail in the "Community Patterns" section), and the hilltop portion of 5GN206. The lowland occupation, in addition to a part of 5GN10, includes 5GN208 (elevation 2292 meters) and the saddle portion of 5GN206. It is possible that the lowland sites on the north side of the Gunnison River represent short-term occupations oriented toward multiple resources rather than a single resource, focal economy. These short-term sites may represent less specificity in location and function than the long-term reoccupied sites on the northside ridgetops or in the southside lowlands. The recognition of the variability in site location function at the regional level is of major importance to the understanding of the cultural ecology of hunter-gatherer systems.

SPATIAL-TEMPORAL PATTERNS

The C14 assays indicate a range of occupation from the early 15th millenium B.P. to the end of the third millenium B.P. (Table 5), with two clusters of dates at about the 6000 B.P. and 4300 B.P. time periods.

Table 4. Material Culture Differences Among Four Site Locations Surrounding Blue Mesa Reservoir

	% Chert	Groundstone/ Flaked Stone	Number of Flakes Recovered	Number of Excavated 2m x 2m Test Pits	Average Number of Flakes per 2m x 2m Test Pits	Number of Bone Fragments
			A. Northside Lowland Sites			
5GN10 Area A	1.73	.12	3363	7	480	-
5GN10 Area B	2.98	.26	773	3	258	1
5GN208w	1.28	.14	700	1	700	-
5GN206 Test Pit 1	1.86	.53	376	1	376	7
			B. Northside Ridgetop Sites			
5GN10 Area D	10.16	2.26	177	4	44	1
5GN10 Area E	7.98	3.68	163	12	14	32
5GN10 Area F	3.38	1.13	622	9	69	20
			C. Southside Lowland Sites			
5GN191	1.97	.01	1018	1	1018	6
			D. Northside Downslope Sites			
5GN247[1]						
6GN204[1]						

1 Data comparable to the remainder of this table are not available from these sites.

Table 5. Radiocarbon Dates from Test Excavations

Site		Provenience	Laboratory[1] Number	Date (Years B.P.)	Boundaries (1 s.d.)
5GN189		.92-1.32mbd	Tx-3632[2]	14,935±610	14,325-15,545
5GN189		1.32-1.72mbd	Tx-3633[2]	12,154±1700	10,454-13,854
5GN205	Area D	Feature 1	Tx-3154	10,094±830	9,264-10,924
5GN191		Feature 11	Tx-3149	8,807±100	8,707-8,907
5GN191		Feature 4	Tx-3624	7,890±240	7,650-8,130
5GN205	Area G	Feature 2	Tx-3156	7,271±110	7,161-7,381
5GN212		Feature 410	Beta-2097	7,065±190	6,876-7,255
5GN191		Feature 1	Tx-3647	6,747±160	6,587-6,907
5GN10	Area F	Feature 11	Tx-3627	6,499±340	6,159-6,839
5GN212		Feature 358	Beta-2104	6,396±110	6,285-6,506
5GN10	Area E	Feature 12	Tx-3621	6,355±210	6,145-6,555
5GN212		Feature 1	Tx-3623	6,283±250	6,033-6,533
5GN212		Feature 251	Beta-2099	6,221±200	6,021-6,421
5GN191		Feature 7	Tx-3646	6,077±950	5,127-7,027
5GN10	Area E	Feature 7	Tx-3619	6,056±160	5,896-6,216
5GN10	Area A	Feature 1	Tx-3625	6,036±600	5,436-6,635
5GN191		Feature 3	Tx-3152	5,984±120	5,864-6,104
5GN210		Feature 365	Beta-2105	5,902±140	5,762-6,042
5GN191		Feature 6	Tx-3155	5,861±170	5,691-6,031
5GN10	Area F	Feature 10	Tx-3628	5,778±560	5,278-6,378
5GN206		Feature 2	Tx-3622	5,583±160	5,423-5,743
5GN196		Feature 226	Beta-2101	5,572±130	5,442-5,702
5GN205	Area G	Feature 1	Tx-3151	4,697±80	4,617-4,777
5GN200		Tp-2 charcoal	Tx-3153	4,656±120	4,536-4,776
5GN205	Area G	Feature 1	Tx-3150	4,563±300	4,263-4,863
5GN10	Area F	Feature 5	Tx-3618	4,419±290	4,129-4,709
5GN205	Area G	Feature 1	Tx-3157	4,398±90	4,308-4,498
5GN247		Test 1	Tx-3620	4,357±410	3,947-4,766
5GN10	Area E	Feature 8	Tx-3630	4,244±90	4,154-4,334
5GN10	Area E	Feature 13	Tx-3631	4,058±260	3,798-4,318

Table 5 (continued)

Site		Provenience	Laboratory[1] Number	Date (Years B.P.)	Boundaries (1 s.d.)
5GN10	Area E	Feature 8	Tx-3629	3,924±130	3,794-4,054
5GN212		Feature 310	Beta-2098	3,234±80	3,154-3,314
5GN210		Feature 28	Beta-2106	2,740±80	2,660-2,820
5GN207		Feature 107	Beta-2103	2,266±100	2,166-2,366
5GN207		Feature 69	Beta-2102	2,266±210	1,990-2,410
5GN247		Test 2	Tx-3626	2,204±130	2,074-2,334

[1] Samples labeled Tx- indicate analysis performed by Balcones Laboratory, University of Texas, while the Beta- prefix designates Beta Analytic, Inc. All dates have been corrected to a half-life of 5,570 B.P., but no dendrochronological corrections have been made.

[2] These samples were bone; all others were wood charcoal.

There is an obvious lack of radiocarbon dates generally around 5000 B.P. and there are only five dates from the post-4000 B.P. period. These patterns, as well as their short- and long-term implications are discussed in this section.

Intra-Site Analysis

Four open sites (5GN205, 5GN10, 5GN212, and 5GN191) contain an extended range of multiple radiocarbon dates suggesting at least repeated intermittent occupations from 10,094 BP to 2204 B.P. There undoubtedly were resource advantages that caused regionally-based hunter-gatherers to continue to return to these sites on an intermittent basis. At 5GN10, the desirable resources may have been the raw material at the quarry site, 5GN1, located across a draw 0.8 kilometers to the west, as well as a general overlook of the valley and the availability of water in Willow Creek. Site 5GN191 may have been located on an animal pathway between the Gunnison River and a spring upstream in an unnamed tributary in Kezar Basin. The environmental advantages at 5GN205 include a valley overview of possible subsistence resources and/or lithic quarry sources in all nearby directions. Site 5GN205 is located close to the "narrows" (Figure 19) where the Gunnison floodplain narrows between enclosing bluffs on opposite sides of the river. The repeated occupation of 5GN212 may be associated with the shelter provided by the surrounding bowl-like topography, or perhaps a game trail, such as possibly occurred at 5GN191.

The eight sites with more than one radiocarbon date indicate an average period of at least intermittent occupation of 2909 years. Site 5GN205 was intermittently utilized for almost 5700 years which represents the longest interval in Curecanti. On the other end of the spectrum, site 5GN207 yielded two contemporaneous radiocarbon dates (2200 ± 110 B.P. and 2200 ± 210 B.P.) from two adjacent hearths.

A single standard deviation is used as an approximate guide to contemporaneity of occupation so that spatial-temporal patterns among the 36 dates can be detected. It is realized that the standard deviation is a statistical concept that superficially bears little relationship to the contemporaneity of in-the-ground occupations at an archeological site. However, the statistic measures the variability in counting the volume of C14 through repeated laboratory trails. A single standard deviation expresses a probability of 0.67 that the true date for the measured sample lies within a range extending from one standard deviation above

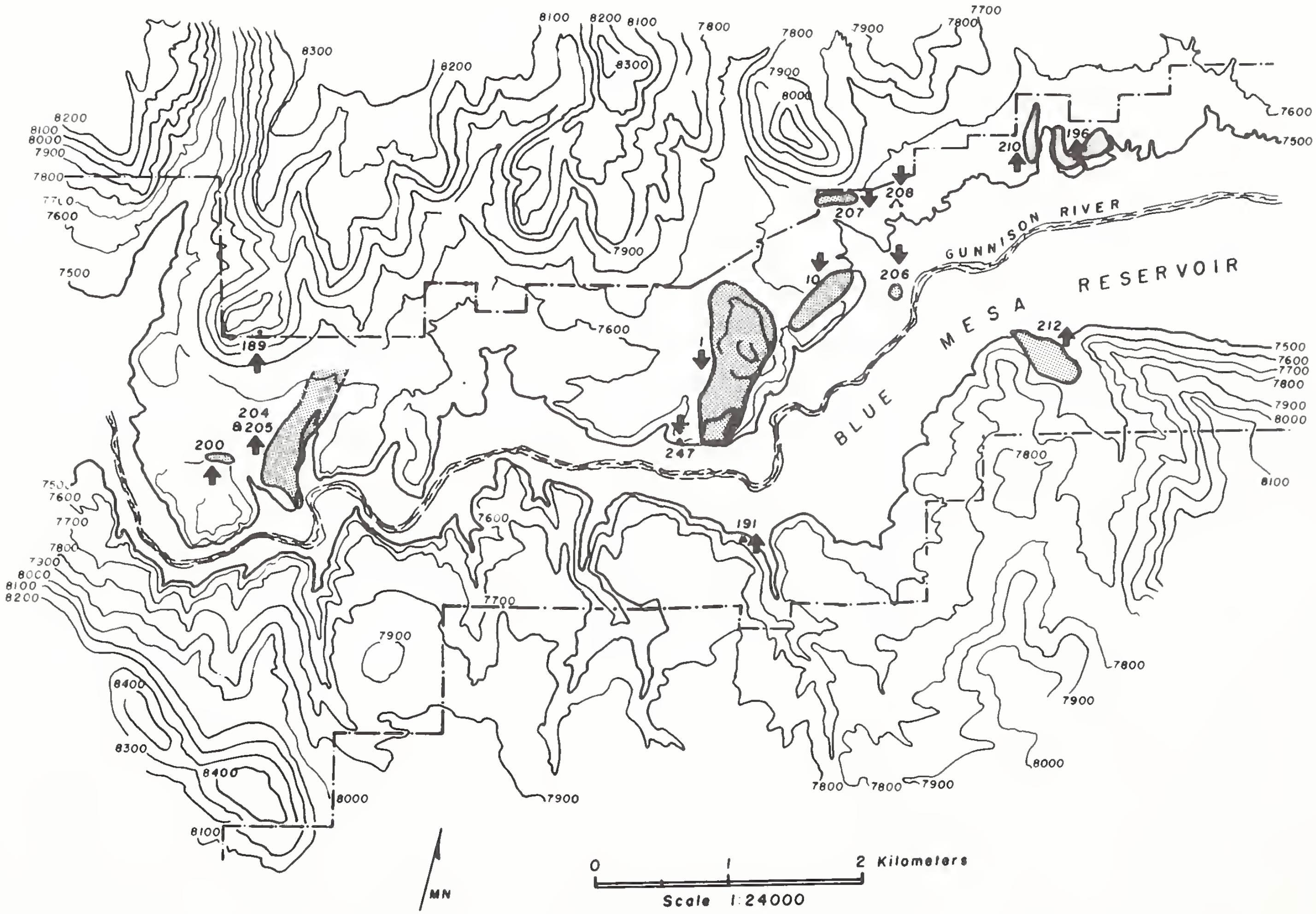

Figure 19. The Location of Archeological Sites Surrounding Blue Mesa Reservoir.

the mean date to one standard deviation below the mean date. In Table 5, right column, the radiocarbon dates from different features are listed to show overlaps at the single standard deviation boundary.

An alternative approach to assessing C14 assays would be to measure the standard deviations obtained from many samples from the same provenience. This would produce a quantitative measure of the variability of the ages of wood used in the features being dated. Older and younger trees may have been used in different burning episodes in the same hearth. A collected charcoal sample submitted for dating may easily include parts of wood of varying ages.

This variability can be estimated by obtaining assays on several samples of charcoal from various places within the same feature. Two excavated features from Curecanti have multiple radiocarbon dates to give a preliminary, non-statistical indication of this variability. Feature 8 from 5GN10 contains two samples (Tx-3629 and -3630) which means that they are 320 years apart, while Feature 1 from 5GN205 has three dates (Tx-3150, -3151, and -3157) with a maximum spread of means of 299 years. Therefore, the difference of sample means is 310 radiocarbon years and the corresponding weighted average spread of standard deviations is 118 years for the general 4700-3900 B.P. period. For comparison purposes, the average standard deviation for 34 dates from the 12 open sites is 238 years.

At 5GN10, there are five clustered dates that range from 6499 B.P. to 5778 B.P. at three different areas (A, E, and F). All 10 possible pairs of date ranges overlap at the one standard deviation level. This chronological overlap apparently represents a single occupation of three spatially discrete areas of the same site. The median of these five dates produces a date of 6067 B.P. for this occupation at the end of the seventh millenium. The occupation of lowland Area A is contemporaneous with the ridgetop occupation of Areas E and F and was probably a part of the same adaptive system. There appears to have been one occupation at 5GN10 as the seventh millenium ended. Solid evidence for occupational contemporaneity comes from 5GN10, where two matching fragments of a broken artifact were found in two separate areas that are radiocarbon dated to 6036 ± 600 B.P. and 6056 ± 160 B.P. These dates were recovered from extreme ends of the same site, approximately 0.5 kilometers distant. Another cluster of four dates from 5GN10 that range in the period from 3924 to 4419 B.P. are provenienced from two distinct ridgetop areas that are 300 miles distant.

Some of these dates overlap, while others do not. These data reinforce the need for absolute dates from adjacent proveniences in order to control time in these repeatedly re-used sites.

The radiocarbon dates from 5GN191 form a consistent pattern; the dates are spaced quite neatly at approximately 1000-year intervals at the beginnings of the ninth, eighth, seventh, and sixth millenia (Table 5). Because this pattern is based on six C14 assays recovered from excavating 36 m2, or approximately 1 percent of the site area, the pattern may be due to sampling error. The cluster of three dates at the beginning of the sixth millenium overlap with each other in all possible pairs, constituting a single occupation with a median radiocarbon date of 5984 ± 120 B.P.

Site 5GN191 is much smaller and more compact, and its occupational space was more intensively utilized than at 5GN10. The site consists of a very dense concentration of hearths and a chipped stone scatter. However, there are no spatial patterns to the distribution of dates among the hearths within the block. Paired contiguous hearths are separated by approximately 200 radiocarbon years, and hearths that are separated temporarily by 3000 years are spatially within several meters of each other. Also, hearths that are closest temporarily are sometimes more distant spatially. More recent occupations were obviously placed among the features and living debris from earlier occupations at this environmentally-preferred location.

The third site with an extended sequence of C14 dates is 5GN205 (Euler and Stiger 1981). The earliest date from a clearly cultural context in Curecanti is 10,094 ± 830 B.P. which comes from an unlined hearth at this site. An isolated, possible posthole yielded a date of 7271 ± 110 B.P.; within approximately 15 meters of this feature, the remains of an apparent wickiup shelter were excavated, producing three

radiocarbon dates between 4398 ± 90 and 4697 ± 80 B.P.

These two extreme dates from Feature 1, Area G obviously do not overlap. The spatial proximity of two features that are approximately 3000 years apart in time is surprising and reinforces the spatial-temporal mixture resulting from the analysis of 5GN10 and 5GN191.

Site 5GN212 is the fourth site with an extended range of radiocarbon dates that are presented in Table 5. Another group of three sites (5GN200, 206, and 196) have produced only one radiocarbon date each. One common pattern is the absence of any dates earlier than the sixth millenium B.P. (Table 5). The sites represent a diversity of environmental settings: lowland, ridgetop, and gravel terrace.

The two very early bone dates from the only cave (5GN189) in the project area require special comment. In general, they indicate the possibility of a very early human occupation, from about 12,000 to 15,000 B.P. However, the dates are stratigraphically disharmonious due to depth reversal (see Table 5). The 14,395 ± 610 B.P. date is from a 40 cm vertical span that includes possible cultural lithic deposits (S. Ahler, personal communication) in association with several Pleistocene faunal forms (Euler and Stiger 1981). The 12,154 ± 1700 B.P. date is from a deeper zone of questionable cultural status.

Within the individual sites, more recent occupations were scattered among earlier occupations. The best example of this is 5GN191 where spatial-temporal compaction is maximal. At the other extreme, the spatial-temporal spectrum is extended at 5GN10, where apparent occupational contemporaneity is spatially dispersed. Also, there appears to be as much temporal diversity within a spatially discrete area of 5GN10 as exists across the entire site. There is little evidence to suggest that any definable area of a repeatedly occupied site was single component in nature.

Regional Analysis

The 36 available radiocarbon dates fall into two clusters between the periods of 6499 ± 340 B.P. and 5572 ± 130 B.P. (14 dates), and 4697 ± 80 B.P. and 4244 ± 90 B.P. (seven dates). The average interval between adjacent dates for the former period is 71.3 years, which includes six different sites. For the latter period involving four sites, the corresponding interval is 75.5 years. These two time periods constitute the most likely times of the entire chronological sequence when occupation of the region surrounding Blue Mesa Lake was nearly continuous. The 13 dates from the remaining 7890 years of dated occupation of open sites at Curecanti yield an average interval between dates of 607 years. It seems that these data are a good basis for determining the rest of occupation outside the two time periods as intermittent.

Certain features from many sites are contemporaneous at the single standard deviation level. These features may have functioned as part of a single hunter-gatherer settlement system that was dispersed across the Curecanti landscape. At the 6000 B.P. period, contemporaneity exists among nine hearths from sites 5GN10, 5GN191, 5GN210, and 5GN212 that are 2.7 km apart. This regional settlement pattern consists of features from lowland southside sites, and ridgetop and lowland sites on the north side of the Gunnison River. The predominance of hearths is consistent with the source of data--charcoal in sufficient amount for dating. The two seventh millenium shelters from 5GN10, as well as a hearth at 5GN212, appear to be part of another occupation of the region at ca. 6400 B.P.

At the 4300 B.P. time period, the following features seem to be part of a regional system: (1) the trash midden from 5GN247, (2) the early occupation of the apparent wickiup shelter (Feature 8) at 5GN10, (3) the adobe pile and timbers from a burned wickiup (Feature 13) at 5GN10, (4) the hearth, cyst, and possibly a pole shelter (respectively, Features 5, 6, and 9, from Area F) at 5GN10, and (5) the wickiup remains (Feature 1, Area G) at 5GN205. This community of hunter-gatherers ranged across at least 3.5 kilometers and included sites found in ridgetop and downslope locations. There are two surprising results: (1) the absence of contemporaneous features from southside, lowland sites, and (2) the rarity of hearths in this settlement reconstruction. Continued investigations may correct this imbalance.

COMMUNITY PATTERNS

It is generally recognized that hunter-gatherers are spatially fluid in the use of the regional landscape in which they range. Several recent studies (Gould 1978; Yellen 1977; Binford 1978) of contemporary hunter-gatherers have mapped the spatial structure of communities that were visited and utilized. These studies generally show the spatial inter-relationships among various portable and non-portable aspects of the archeological record. This section is an attempt to replicate archeologically the community patterning evidenced in the ethnographic accounts of contemporary hunter-gatherers. The on-the-ground materials and spatial structures recovered from six block excavations of 188 m2 at three sites in Curecanti are the data base.

The results are meant as working hypotheses, rather than as final interpretations, concerning the community organization of Curecanti hunter-gatherers.

Yellen (1977:91,105) has documented the importance of hearths as a center of prehistoric community life for technological, subsistence, and social purposes. These hearth-centered activity areas are archeologically meaningful because they can provide the radiometric data base for establishing contemporaneity of occupation. The following section therefore focuses on hearths for both of the above reasons. The Curecanti archeological sites are not a useful spatial concept for the analysis of synchronic community patterns because of the temporal mixing of occupations as discussed in the previous section. Activity areas spatially defined through differential distribution of lithic materials also are less useful than hearth-centered areas for the same reason.

Our best reconstructions of site structure and community organization come from sites 5GN10, 5GN205, and 5GN191 where the largest block excavations have been carried out to date. At 5GN10, blocks of 48 m2 in Area E and of 32 m2 in Area F resulted in the discovery of nine features, including apparent wickiup shelters, in the 6000 B.P. and 4000 B.P. time range. At 5GN205, two blocks of 52 m2 each have been completely excavated at Areas G and D respectively. At 5GN191, blocks of 16 m2 and 8 m2 have been excavated.

Dates from two features in Area E at 5GN10 appear to represent contemporaneous parts of the same community at ca. 6200 B.P. (Figure 20). Feature 7 is a slab-lined hearth containing the densest concentration of faunal specimens from any clearly cultural provenience in the Blue Mesa area. The fill also consists of 19 flakes, one of which was utilized. Within 2 m of Feature 7, a concentration of adobe chunks next to an adobe-collared posthole was identified as Feature 12. This appears to be a remnant of a shelter; Feature 7 may have been the hearth associated with the shelter.

Area E at 5GN10 also provides tantalizing evidence for a synchronic, wickiup community (Figure 20) at the ca. 4000 B.P. time period. Feature 8 is the remnant of a possible burned wickiup approximately 5 m in diameter. Within this larger, lightly charcoal stained area of soil is a smaller, heavier stained soil area enclosing remnants of at least four burned ponderosa pine poles. Neither a compacted floor surface nor any interior features were found within the 0.5 miles wide test trench that was excavated through the center of the stained area. Mano and metate fragments were found within the larger stained area, suggesting that plant processing was performed within the wickiup. Within three meters of this area, a similar adobe pile and radiating burned poles were identified as Feature 13. The date for Feature 13 has a large standard deviation that overlaps with both extreme dates from Feature 8.

Area F at 5GN10 contains additional tentative evidence for community organization, in the form of three excavated features that are in a loose chronological association. Feature 9 is a possible wickiup defined by a semi-compacted floor with artifacts and a circular posthole pattern (Figure 21). It postdates ca. 5778 B.P., since one of its postholes intrudes into an earlier feature yielding a radiocarbon of that time, and it may be contemporary with a slab-lined hearth (Feature 5) dated to 4419 ± 290 B.P. The presence of one of the largest bone assemblages from the project raises the possibility that animal processing may have been performed in the hearth. A slab-lined storage cyst appears similar in construction style to, and may have been contemporaneous with, Feature 5. The prehistoric scattering of fire-cracked rock uniformly across the top of both

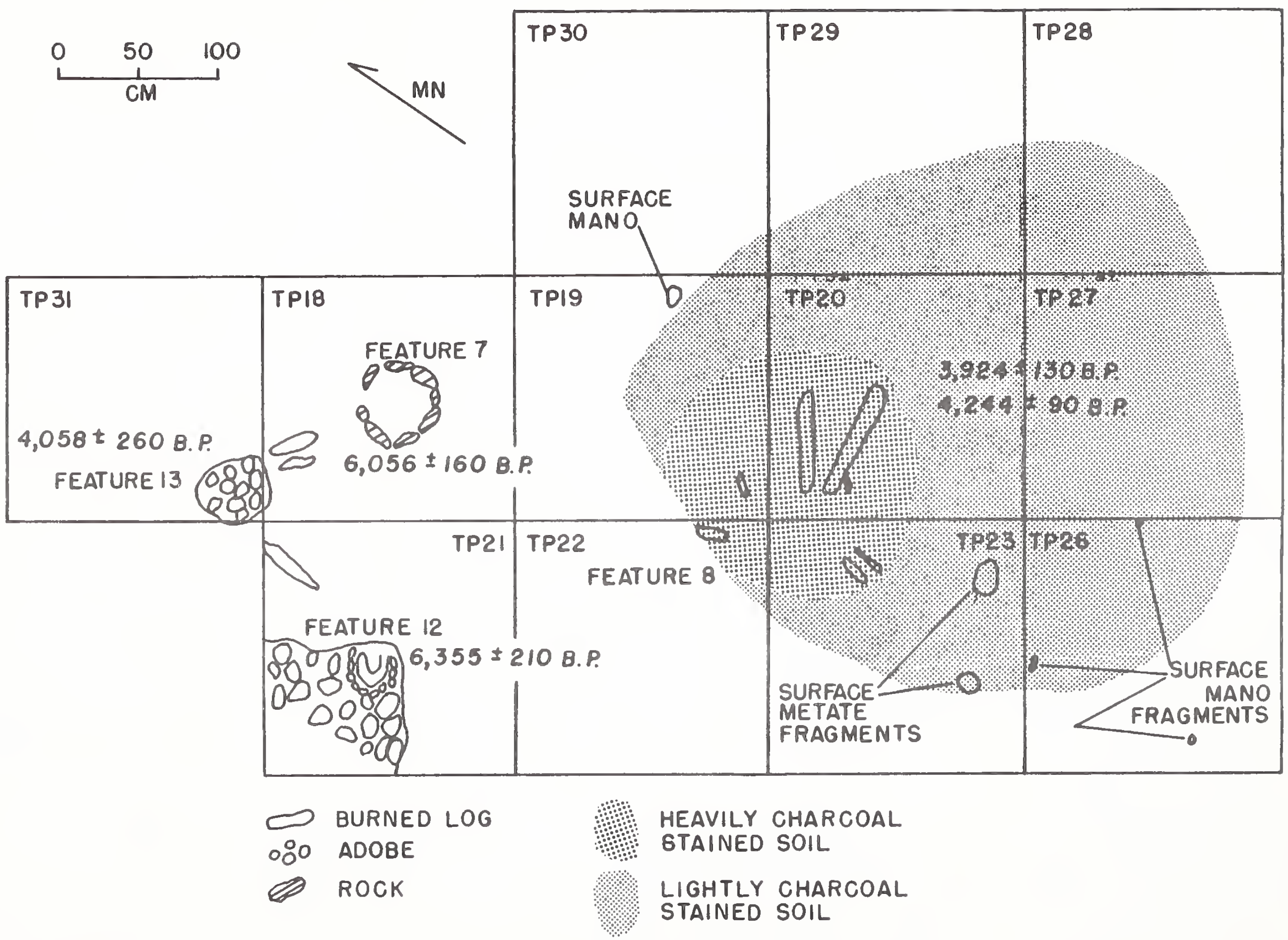

Figure 20. Plan View of Area E at 5GN10.

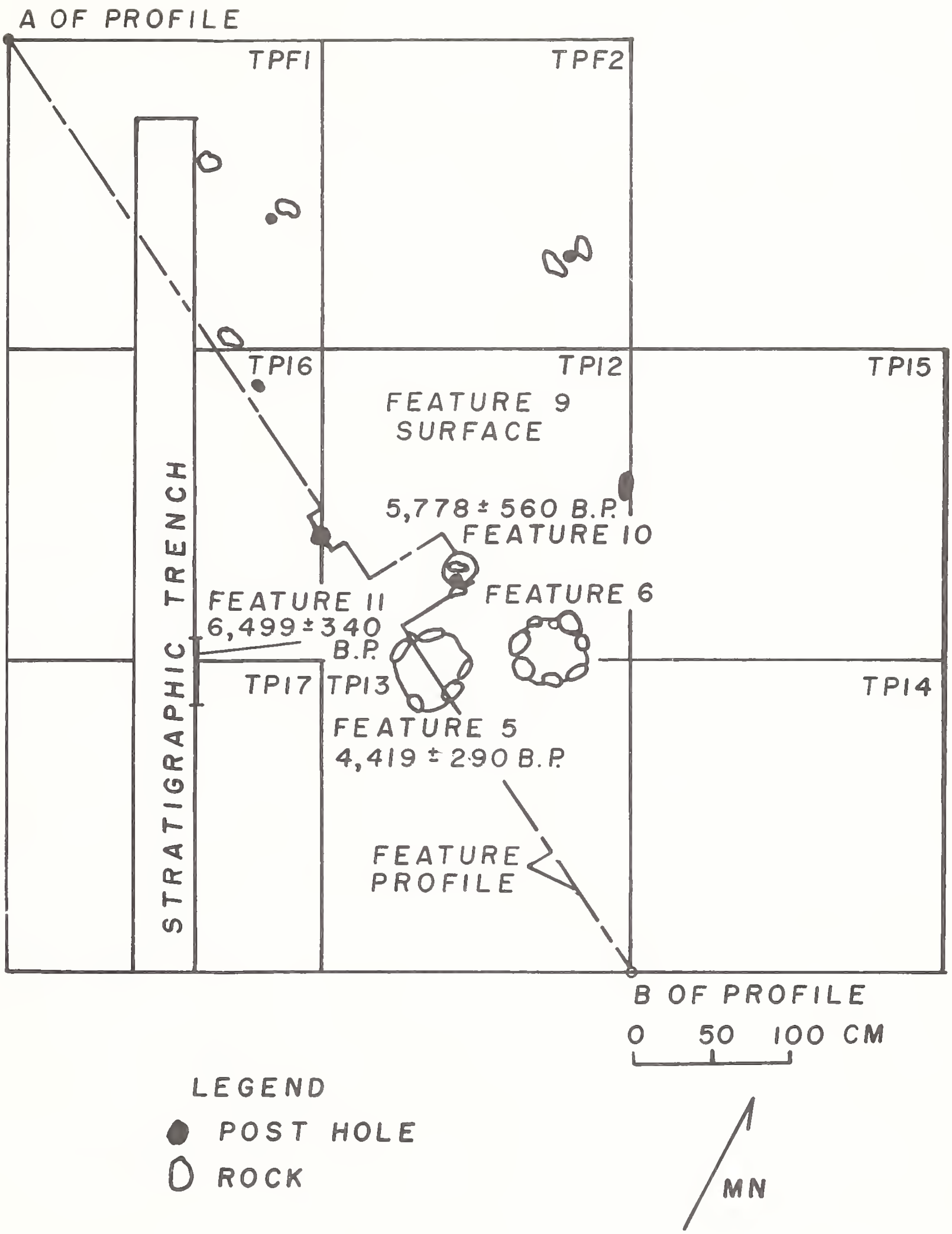

Figure 21. Plan View of Area F at 5GN10.

Features 5 and 6 also argues for their contemporaneity. Thus, it appears that this possible post 5778 B.P. community may have consisted of a wickiup shelter with an exterior hearth and storage cyst. The latter's contents include chipped and ground stone as well as an Artiodactyla vertebra and an incomplete elk skull with two antler bases. The storage of chipped and ground stone suggests an intention to return to the site which is consonant with the intermittent site use indicated by the chronological analysis.

The block excavation of 52 m2 at Area G of 5GN205 encountered only one synchronous feature that provides information concerning community organization. Feature 1 (Figure 22) is another apparent wickiup structure that is roughly diamond shaped with a maximum dimension of 3.5 miles. A pile of adobe chunks with log impressions suggests that the upright poles were anchored by adobe and pole cribbing. Within the feature's perimeter, core material, ground stone fragments, and two shallow pits were encountered. These remains suggest an interior hearth for heating or food processing. The three activities--lithic caching, plant processing, and heating/cooking (the latter suggested by the presence of mammilian bone fragments)--probably represent a single occupation surface within the shelter. These burned rocks may constitute the only evidence at Curecanti for the interior heating of shelters and consequently for cold weather occupation. Other features at Areas G and D cannot be associated as part of a community because of the lack of apparent contemporaneity.

The 16 m2 block excavation at 5GN191 has several spatial patterns (Figure 23). The most interesting characteristic is the four pairs of hearths clustered at the western end of the block. Single, unpaired hearths are located to the eastern end of the block. Also, the largest hearth in three of the four pairs is oriented to the north. As Table 6 indicates, the contents of the feature fill differ between the paired and unpaired hearths. The former contain an average of 10 flakes per hearth. The meaning of this distribution is unclear because the flakes were all non-utilized; possibly these partially empty hearths were used for trash disposal. A second pattern is that in all three cases of north-south oriented, paired hearths, the northern hearth contains more lithic specimens than the southern hearth. Also the only projectile point and all of the chert flakes from feature proveniences in the entire 36 m2 of excavation (including isolated test pits) at this site were recovered from the paired hearths.

Features 3, 6, and 7 yielded radiocarbon dates that suggest a contemporaneous camp with a median occupation date of 5984 B.P. As Figure 23 shows, Features 6 and 7 constitute a paired hearth while Feature 3 is several meters distant. This camp includes one hearth with the densest concentration of non-utilized flakes, which may indicate the re-use of an empty hearth for trash disposal. Another three-hearth synchronic community exists at the ca. 6283 $\pm$ 250 B.P. time period at 5GN212 and includes Features 1, 25, and 358.

SUBSISTENCE

The subsistence base of the ridgetop sites may have been the exploitation of pinyon nuts which were an important resource for many historic native people in the western United States. This exploitation pattern was present in eastern California as early as 4500 B.P. (Thomas 1971). As yet, no macrofloral evidence of the use of pinyon nuts as a food resource has been recovered at Curecanti, but it is possible that the ground stone assemblage was used in the reduction of pinyon nuts to meal or flour for consumption. The evidence for the burning of pinyon pine in fire hearths dates from 7890 B.P. to 4419 B.P., and there is a cluster of dates from pinyon charcoal at the ca. 6000 B.P. time period from sites 5GN10 and 5GN212. It is likely that pinyon pine existed in the close vicinity of the Blue Mesa Reservoir location during this time, and it is also likely that pinyon stands were fairly close, since pinyon was used for firewood. It is offered as an hypothesis that the reason for few prehistoric sites in Curecanti after 4000 BP is that there was a local extinction of pinyon pine which may have resulted in the loss of pinyon nuts as a subsistence base.

All of the faunal remains thus far recovered from two seasons of excavation have been highly fragmented. One jawbone of woodrat (*Neotoma* sp.), a few fragments of mountain sheep bone (*Ovis canadensis*), and one elk (*Cervus canadensis*) skull

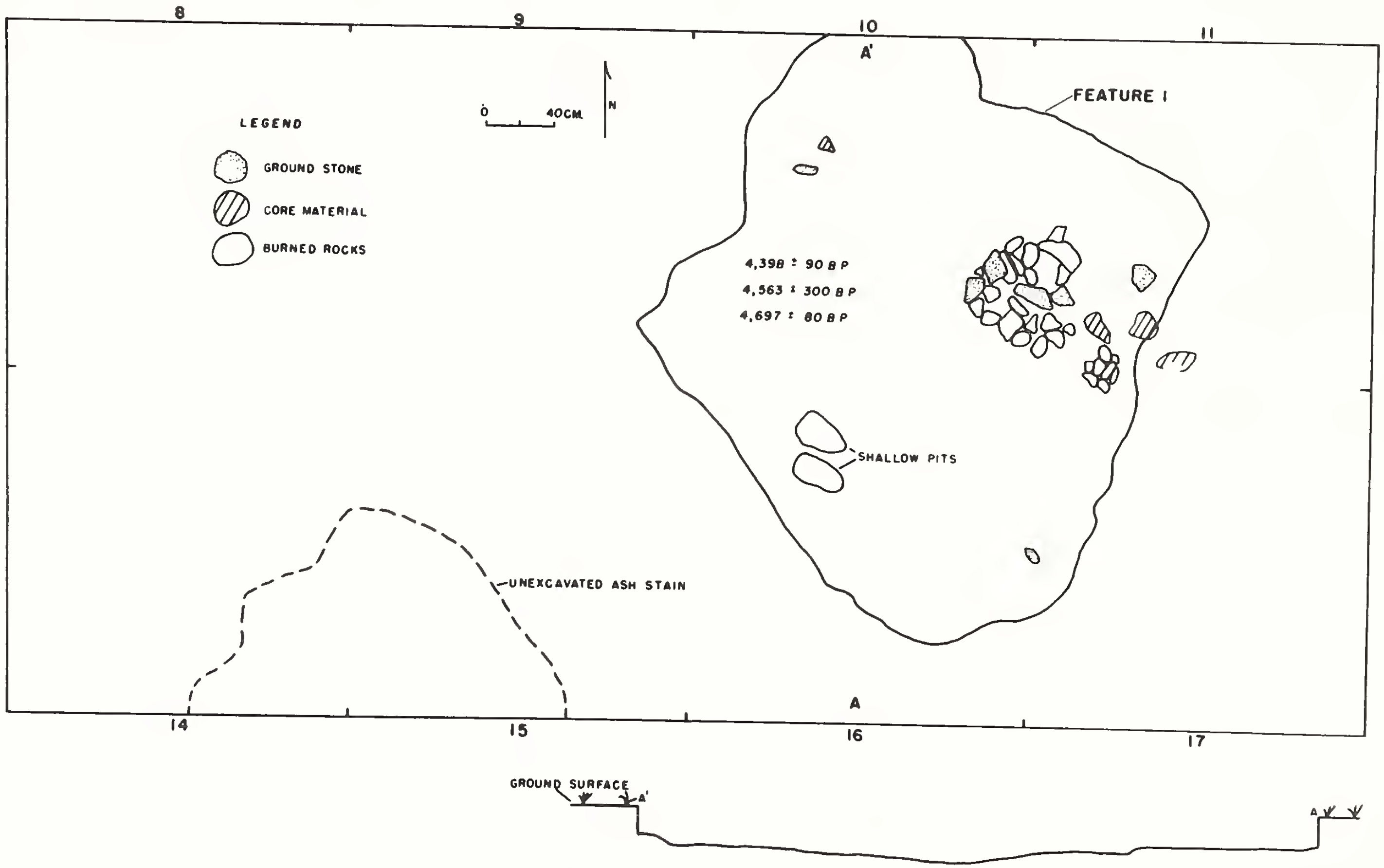

Figure 22. Profile and Plan View of Feature 1 at Area G at 5GN205.

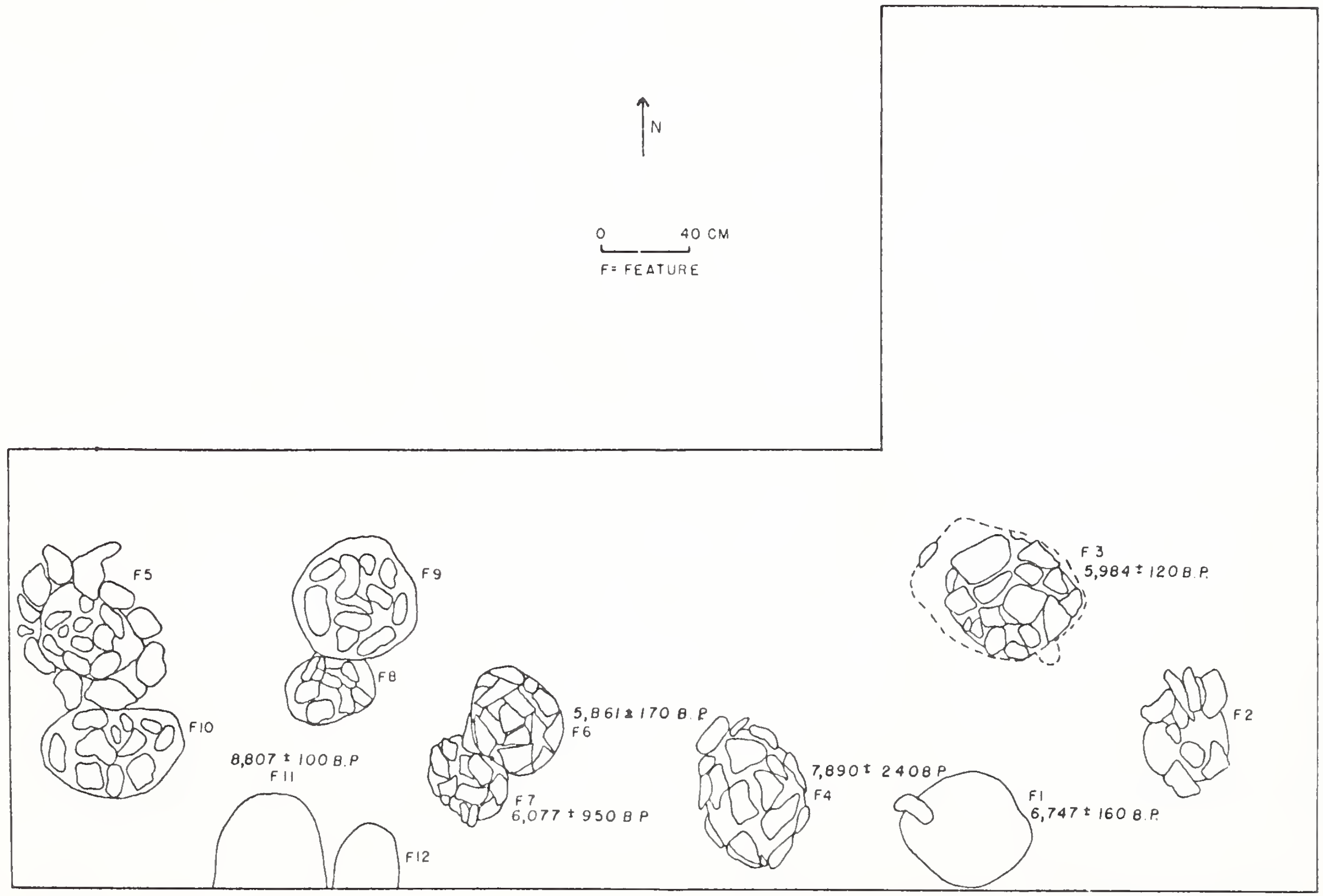

Figure 23. Plan View of Hearths at Area A at 5GN191.

Table 6. A Comparison of the Lithic and Faunal Assemblages from Paired and Isolated Hearths at 5GN191

Feature Number	No. of Flakes Non-utilized Quartzite	Chert	Other Lithic Artifacts	MNI[1] & Faunal Material	Radiocarbon Dates (B.P.)
		A. Paired Hearths			
5	10	1	0	0	
10	0	0	0	0	
9	2	1	1 Proj. Pt.	1 Ovis	
8	1	0	0	0	
6	24	0	0	0	5,861 $\pm$ 170
7	0	0	0	1 Mammal	6,077 $\pm$ 950
11	1	0	0	0	
12	0	0	0	0	
SUBTOTAL	38	2	1	2	
		B. Isolated Hearths			
1	3	0	0	1 Mammal	
2	0	0	0	0	
3	1	0	0	0	5,984 $\pm$ 120
4	1	0	0	0	
13	1	0	0	0	
14	0	0	0	0	
15	0	0	0	0	
SUBTOTAL	6	0	0	1	

[1] Minimum Number of Individuals

fragment are the only faunal remains thus far identified from definite cultural contexts (Emslie 1981; and Euler and Stiger 1981). Many of the fragmented large mammal bones are of mountain sheep size, so it is possible that the mountain sheep was an important food animal. Hunters knowledgeable about mountain sheep behavior and familiar with the land can efficiently hunt this herd animal. Perhaps the two most effective hunting techniques are game drives and salt lick ambushes (Packard and Scott 1946; and Binford 1978). Benedict and Olson (1978) have shown that mountain game drive systems were being used in northern Colorado during the "Altithermal." The 1976 Curecanti survey area did not include the high-altitude territories of mountain sheep, but prehistoric hunting forays from the Curecanti area to mountain sheep territories are possible.

5GN191 and 5GN212 may be examples of sheep hunting and butchering camps. A few bone fragments, one identifiable as mountain sheep (Emslie 1981), and many fragmented stone tools were found among the 87 hearths exposed on the surface at 5GN191. Slow springs which occur a short distance from each site may have brought game to the location, although the permanent Gunnison River (1609 meters away) would probably have been more attractive. Further investigation of these sites and the spring areas would aid in our understanding of these sites, while survey work in high elevation areas may yield evidence of local game drive systems. Consideration should also be given to the possible effects of the "Altithermal" and "Little Ice Age" on

the productivity of the grazing range for mountain sheep.

A PALEOENVIRONMENTAL RECONSTRUCTION

The archeological sites tested during 1978 (Euler and Stiger 1981) and 1979 (Stiger 1981) at Curecanti apparently represent a cultural adaptation during the "Altithermal" and "Anathermal" climatic periods, as defined by Antevs (1948). During the Altithermal period (8000-4000 B.P.) the local vegetal environment was apparently different than the modern one, as shown by the prehistoric presence of pinyon pine. There appear to be two major possibilities for the change in vegetation. The first possibility is that the climate is different today than during the Altithermal. The modern climate may prohibit the pinyon from growing in the upper Gunnison Basin. The second possibility is that, while the climate has changed, the major limiting factor is the topographic situation of the Curecanti area (Stiger 1980).

Pinyon pine presently occurs outside of the upper Gunnison Basin in areas of comparable elevation and climate to Curecanti. In addition, a group of small mammals has been noted as being absent from the Gunnison Basin where suitable habitats could be found (D. A. Armstrong, personal communication). Interestingly, the pinyon pine and the small mammals presently absent from the basin all have maximum distributional elevations below 2591 meters to 2743 meters elevation (Armstrong 1972; Harrington 1964). Almost all living plants and animals found in Curecanti (Woodbury, Durrant, and Flowers 1962) have maximum distributional elevations over 2743 meters.

It has been suggested that the basin topography of the Gunnison area and the cliffs of the Black Canyon have limited biotic access into the Gunnison Basin (Stiger 1980). The prehistoric presence of pinyon and possibly of some animals that are absent today has two implications. First, a mechanism had to allow the species access into the basin, and second, a later mechanism had to kill them off and keep them out. It has also been proposed that this environmental change was the result of fluctuating elevational limits of life zones caused by climatic change (Ibid). These climate changes correspond to those of the Altithermal and the "Little Ice Age" (Antevs 1948; Matthes 1939). The pinyon-juniper zone would have to have risen approximately 152 meters to 305 meters to have elevated the life zone "over the hump" of Blue Mesa Pass (to the west). This would have allowed the pinyon-juniper zone to spill over into the upper Gunnison Basin. It would have taken place sometime before 7900 B.P., which is the earliest date for pinyon charcoal found in the Curecanti excavations. The change in occupation in Curecanti after 3234 B.P. may be a reflection of this changing environment.

Significantly researchers in the western United States have seen similar environmental changes reflected in radiocarbon dated pollen and macrofossil remains. Carrara (in Mode 1980) has found conifer wood above the present treeline in the San Juan Mountains of Colorado. The dates on some of this wood are " ca. 7800 B.P." (Mode 1980:30). Pollen data from the La Plata Mountains of Colorado indicate two timber-line advances between 9800 and 6000 B.P. with a retreat to lower elevations shortly after 4000 B.P. (Peterson and Mehringer 1976:275). Waddington and Write (1974) see pollen evidence of the Altithermal in the Yellowstone Wyoming area between 9000 and 4500 B.P. Pollen and macrospecimens from the San Juan Mountains of Colorado indicate a higher treeline between 8000 and 3000 B.P. (Andrews et al. 1975:194). Some of this San Juan material comes from the Gunnison Basin near where Pleistocene elephants and bison have been found (Cook 1931). Additionally, researchers working with tree stumps and snags in California have found an approximate 152 miles elevational rise in treeline sometime before 7400 B.P. This high California treeline lasted until about 4200 B.P. (La Marche 1973; and La Marche and Mooney 1967).

A downward shift in life zones corresponding with Matthes' (1939) "Little Ice Age" could explain the paucity of post-Altithermal sites in Curecanti. If the prehistoric human niche was closely adapted to some element or elements in a particular environment such as pinyon pine and that environment changed sufficiently and the elements became locally extinct, then abandonment of that locality might have been necessary. Human reoccupation of the area would come about only with the adaptation to a new niche or the return of the critical resources.

If the upper limit for pinyon dropped below 2195 meters (the lowest elevation in the upper Gunnison Basin), pinyon pine at that time would have disappeared from the Basin. This upper limit may be set by annual precipitation amounts, since at around 38 cm per year ponderosa gains a competitive advantage over pinyon (Woodbury 1947). Regardless, at some time around 4000 B.P. the pinyon zone levels apparently dropped below 2195 meters in elevation and at no time since then has pinyon moved back into the upper Gunnison Basin. The discovery of more recent, post-4000 B.P. sites in Curecanti without pinyon pine would support this conclusion.

The fluctuating environmental zone model proposed here has some interesting implications for archeological research outside of the Curecanti area, such as Bettinger's (1975) research on lithic scatter sites in Owens Valley, California. By mapping typologically dated surface material across the valley, he reconstructed settlement patterns through time. He then related these to modern vegetation zones and hypothesized about the changing prehistoric use, including the inception of pinyon collecting about A.D. 6000. The Curecanti material indicates that the modern vegetation zones may not reflect prehistoric ones. While Bettinger (1975) acknowledged the rise in life zones, he ignored more recent possible drops. His reconstructed sequence of Owens Valley settlement patterns with respect to modern life zones might be questioned.

SUMMARY

The period of occupation at Curecanti extended primarily between <u>ca</u>. 10,000 B.P. and 2200 B.P., with the majority of radiocarbon dates falling at about 6000 B.P. and 4300 B.P. It is hypothesized that regional occupation was particularly intensive and nearly continuous in the period between <u>ca</u>. 6500 and 5600 B.P., while the episodes of use of individual sites was discontinuous. Another period of intensive and perhaps continual occupation of the Basin occurred between <u>ca</u>. 4700 and 4244 B.P. There are suggestions of an early occupation (<u>ca</u>. 15,000 to 12,000 B.P.) of a cave just outside the National Park Service boundary and of more recent, post 2200 B.P. occupations. Occupational gaps occurred at about 5000 B.P. and again in the middle of the fourth millenium B.P. The strongest generalizations about the archeological record in Curecanti is the rarity of single component sites and the intermixing of more recent occupations with older occupations.

A strong functional distinction exists between the (1) ridgetop sites where habitation shelters are found and where animal and plant processing were probably performed, and (2) lowland sites which were the locus of lithic reduction, but which lack habitation shelters. The dominant settlement preference for the contemporaneous occupation of northside ridgetop and southside lowland locations was established by 8807 ± B.P. and may have begun as early as the 10th millenium B.P. The added preference of northside lowland locations seems to have developed by 6036 ± B.P. 100.

A paleoenvironmental model of life zones that fluctuated altitudinally with the changing Altithermal climatic regime is also postulated. It appears that the pinyon pine community entered the upper Gunnison Basin at <u>ca</u>. 8000 B.P., when its upper limits rose high enough to enter the topographically restricted basin. The biotic community then disappeared after 4000 B.P., when its upper limits dropped below the minimum elevation of 2195 meters in the basin. The excavated and dated floral evidence includes ponderosa and pinyon wood which were used during this period as a fuel source.

Minimum parts of four separate community types have been identified from the block excavations conducted in Curecanti. All four are found on northside ridgetop locations, except for the hearth communities at 5GN191 and 5GN212, which are in southside lowland locations. The latter is also the only community type that lacks apparent wickiup shelters.

The first multi-feature community consists of the earliest wickiup shelter (6355 ± 210 B.P.) in Curecanti and is associated with an exterior, hearth-centered activity area. The second type, the three-hearth community, is dated to approximately 5984 ± 120 B.P. at 5GN191 and to 6283 ± 250 at 5GN212. At the former site, the grouping consists of a pair of contiguous hearths and an isolated hearth. There is also patterned variability in the debitage frequencies from this community, which is probably a contemporary part of a

regionally-based adaptive system that includes six additional hearths at site 5GN10, 5GN210, and 5GN212. This community minimally includes southside lowland, and northside ridgetop and lowland locations and has a median date of 6046 B.P. All its activities seem to have been performed out-of-doors. The possible wickiup shelter at 5GN10 dates from an earlier time period and cannot be considered contemporary with this larger regional community.

A third community type with a storage capacity has been reconstructed for the post 5778 B.P. period at 5GN10; it consists of a possible wickiup shelter with an associated exterior hearth and storage cyst. The documentation of a storage facility sometime after the beginning of the sixth millenium B.P. has significant implications for the Curecanti hunter-gatherers populations.

The first indication of interior heating of shelters appears as early as 4697 ± 80 B.P. A diversity of interior domestic activities including possible heat/cooking, lithic caching, and plant processing is known from this isolated shelter at 5GN205.

A fourth community type is suggested by the first appearance of a multi-shelter community at the end of the fifth millenium B.P. and includes an interior locus for plant processing at 5GN10. This site-based community may be a contemporary part of larger regional system that dated to ca. 4300 B.P. It was more diverse than the earlier 6046 B.P. regional community and included hearths, a midden area, a storage cyst, and the remains of four apparent wickiups. The latter were made with adobe, timbers, and postholes, and were occasionally the locus for interior activities including plant processing, lithic caching, cooking, and heating.

These communities were aspects of the larger regionally-based, fluid system that may have contributed to the adaptive longevity of the local Archaic hunter-gatherers. These partial communities are considered as "structural poses" (Gearing 1962), a concept that is useful in understanding the archeological record of these hunter-gatherer populations. The structural poses may be related to seasonality, geographical location, or adaptational change over time. They should not be construed as fixed types, but rather as cultural building blocks that could have been combined in various permutations to enhance the adaptability of the prehistoric human populations in Curecanti.

Several diachronic patterns indicate that communities were becoming more complex through time. The appearance of a storage facility and of a possible multi-wickiup community are two examples of increasing community complexity in the final one-third of the fifth millenium B.P. These phenomena, as well as the interiorization of domestic activities in the middle of the fifth millenium B.P., coincided with the terminal phase of the "Altithermal." These three innovations preceded the rather abrupt interruption of occupation from about 3924 B.P. to ca. 3234 B.P.; they may be interpreted as adaptive experiments that were attempted to accommodate the climatic shifts beginning during the terminal portion of the "Altithermal."

PART FIVE: HIGH-ALTITUDE ADAPTATIONS IN NEW MEXICO

JEMEZ MOUNTAIN OBSIDIAN EXCHANGE
A VIEW FROM REDONDO VALLEY

Joseph C. Winter

INTRODUCTION

An analysis of the distribution of obsidian material and tool types can be a valuable approach to the study of prehistoric exchange.[1] Ericson (1977), for example, has shown that trade in obsidian was a factor in the organization of California egalitarian exchange systems, and there is evidence that the Bodie Hills source was a quarry workshop that was used exclusively for producing bifaces and blades for export (Singer and Ericson 1977). Research in Guatemala and the Yucatan has indicated that competition between two highland obsidian source areas for the lowland market was an important Classic Period Mayan organizational feature (Hammond 1972). By Late Classic or Post Classic Mayan times, the development of a more efficient transportation system allowed a more extensive and regular use of obsidian, which was now a "devalued" utilitarian item (Sidrys 1977:104). In the Late Formative period in the Basin of Mexico, the production and exchange of obsidian tools was apparently associated with the emergence of high status groups, the development of craft specialization, increases in population density, and the evolution of economic stratification (Santley n.d.). The Anasazi obsidian exchange system in Chaco Canyon also changed over time, from a general procurement strategy that used a variety of sources in Basketmaker III times, to a much more specialized system after A.D. 700 that was dependent primarily on one source (Sappington and Cameron 1981). Elsewhere in the Southwest there is evidence that the Late Sinagua procurement of obsidian involved specialized processing and procurement centers (Brown 1981).

This chapter discusses the role of obsidian exchange in the PaleoIndian, Archaic, and Anasazi periods in northwestern New Mexico. While the discussion centers on obsidian tools from 21 workshop sites in Redondo Valley in the Jemez Mountains, information from the San Juan Basin and elsewhere in the Southwest is also analyzed. Changes in the distribution and use of Jemez Mountain obsidian were apparently correlated with alterations in regional exchange systems. It is proposed that the exchange of Jemez Mountain obsidian evolved from a generalized, uncontrolled pattern in Paleo-Indian and Archaic times, to a highly controlled, specialized pattern in prehistoric Anasazi times. These differences may have been associated with the change from an egalitarian to a hierarchical exchange system.

THE REDONDO VALLEY WORKSHOPS

The primary data in this discussion were obtained from excavations at 21 obsidian artifact scatters along Redondo Creek, in the Jemez Mountains (Baker and Winter 1981). This research was carried out by the Office of Contract Archeology of the University of New Mexico to mitigate the adverse effects of the development of a geothermal power plant. Redondo Valley is part of the Valles Caldera, a collapsed volcano that forms the heart of the Jemez Mountains (Figures 24-25). Redondo Creek, a headwater tributary of the Jemez Pueblo ritual area (Weslowski 1981). Elevation in the 1984-acre (8035 km2) project area varies from 8000 feet (2432 meters) to 9600 feet (2918 meters).

Small quantities of low grade obsidian nodules occur naturally in the passes at the eastern end of the valley, while the Valle Grande immediately to the east is one of the prime sources of high grade obsidian in New Mexico. Obsidian from the Valle Grande, Obsidian Ridge, and other areas associated with the Valles Caldera are

[1]Exchange is here considered in its broadest sense; i.e., it is defined as the procurement and transportation of articles, by a variety of means (cf. Renfrew 1977:72).

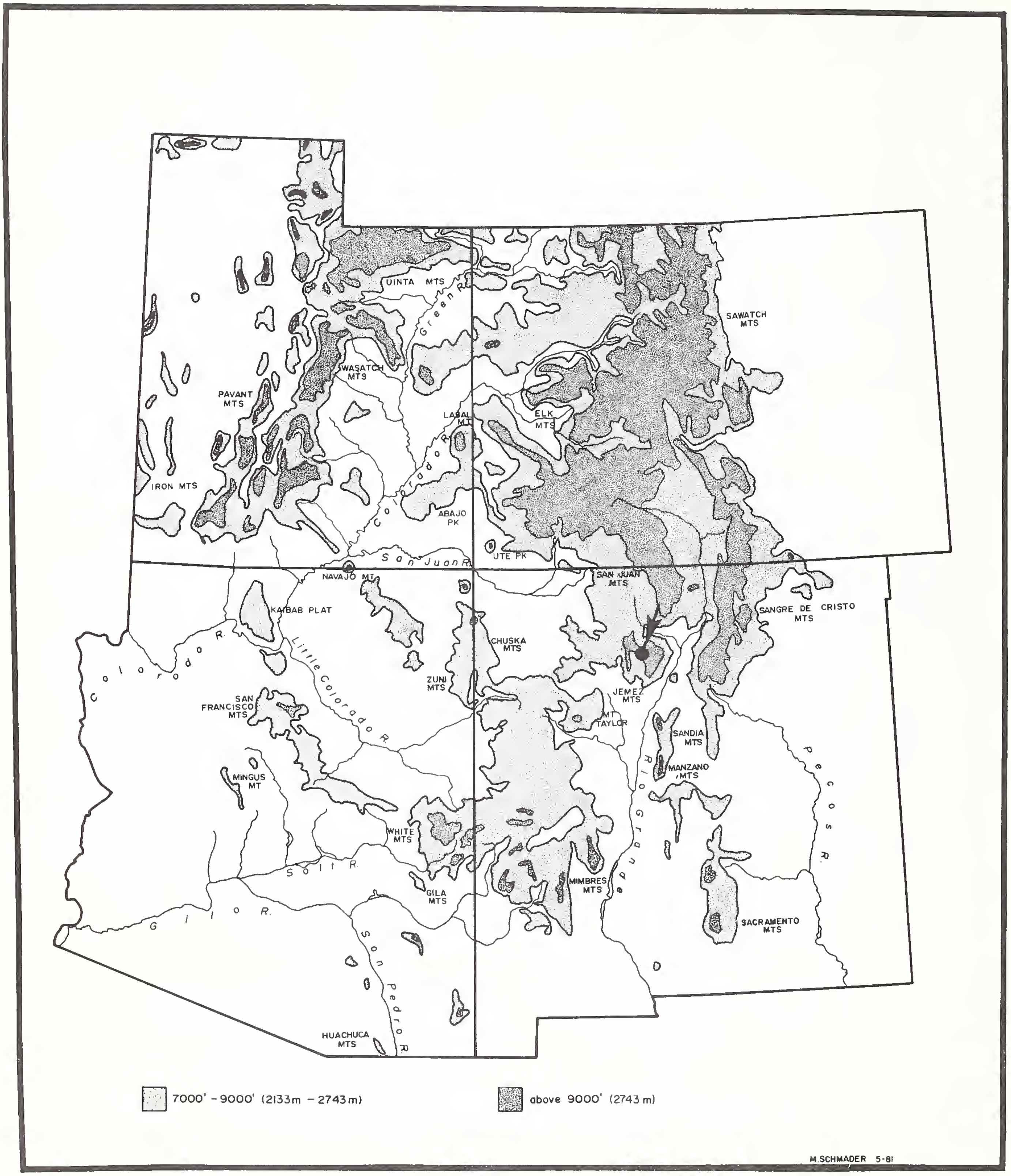

Figure 24. General Location of Redondo Valley and the Jemez Mountains.

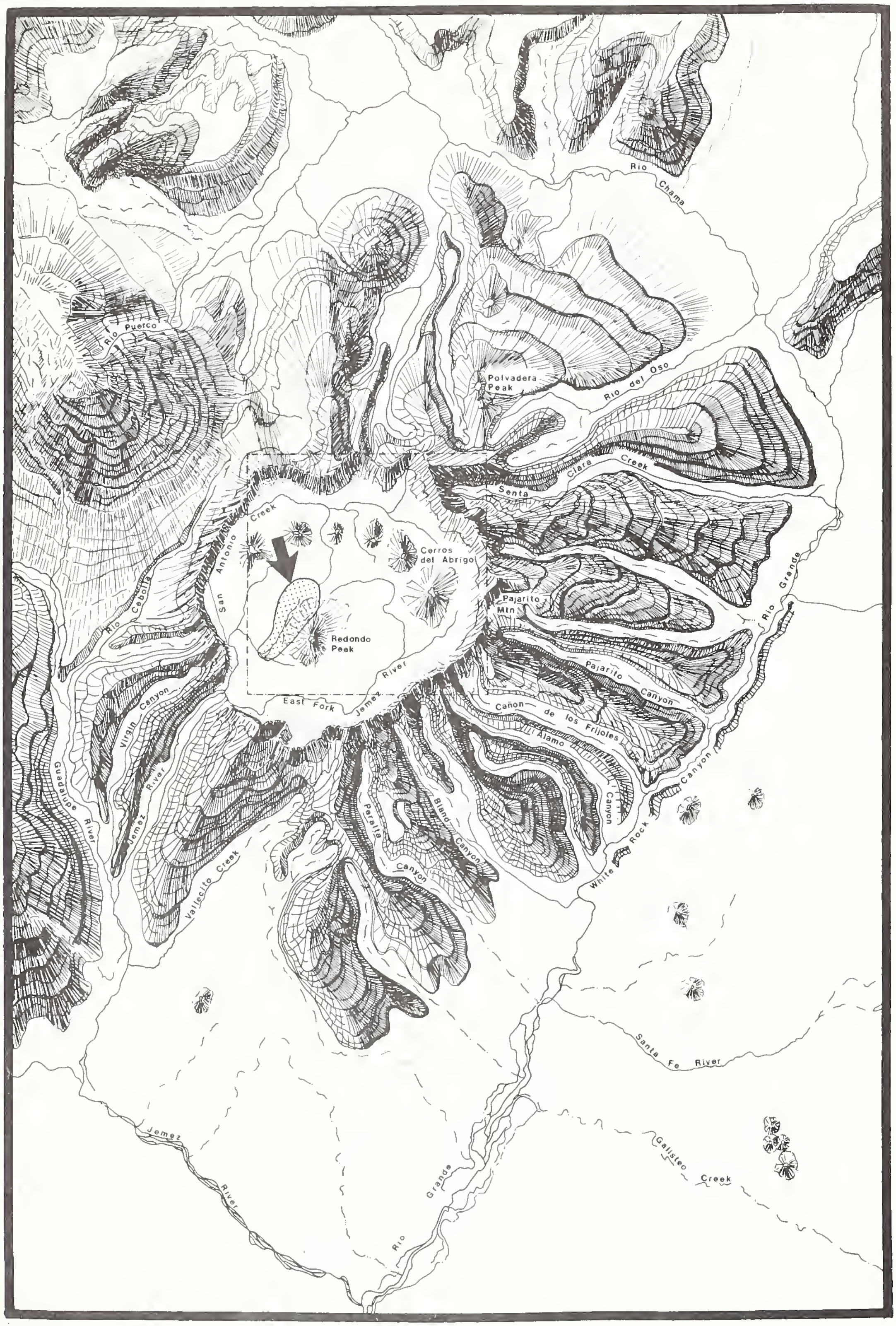

Figure 25. Location of the Redondo Valley Project Areas in the Valles Caldera.

collectively termed "Jemez Mountain" obsidian. Valle Grande obsidian is extremely fine grained and glassy, and much of the floor and flanks of the Valle are scattered with nodules varying in size from a few centimeters across to a meter in diameter (Winter 1981a). In a recent survey of a 45 kilometers transect across the Valle Grande, Eck (1980) encountered six major source areas of obsidian nodules. The smallest measured over 600 feet (200 miles) across, and the largest was nearly 4500 feet (1.5 kilometers) in diameter.

The surface collections and excavations at the 21 artifact scatters in Redondo Valley and the subsequent analyses demonstrated that the sites were workshops where obsidian from the Valle Grande was modified into bifaces and other formal tools. The sites ranged from .75 m2 to 60,000 m2 in size, and yielded from 4 to 8177 artifacts. A total of 130 randomly located and 130 nonrandomly placed 1 by 1 meter units were excavated. Although they removed less than one percent of the volume of the sites, over 23,000 artifacts were recovered. No hearths, structural remains, storage pits, or other obvious features were noted, and the 21 sites were all composed of amorphous artifact scatters that represent short-term workshops. Out of the nearly 24,000 artifacts recovered during the project, 99.2 percent were obsidian, 144 were chert or chalcedony, 24 were sandstone, and the remaining 24 were composed of five other materials. Only 49 of the artifacts were grinding stones, and only three percent of the rest of the assemblage were projectile points, utilized flakes, or other tools.

Debitage and trace element analyses (Baker and Heinsch 1981; Sappington and Baker 1981) demonstrated that the primary activity that occurred at the sites was the production of bifaces from Valle Grande obsidian. A few projectile points were manufactured and used locally, but most of the bifaces were exported out of Redondo Valley. Other activities, such as hunting and plant processing, also apparently occurred at or near the sites, but the production of bifaces was clearly of major importance, at least as suggested by the lithic debris and the general absence of food processing, storage, habitation, and other features. These activities occurred over a period of several thousand years, as individuals and small groups from nearby low elevation regions visited Redondo Valley on a sporadic, short-term basis. The obsidian hydration sequence suggests use from approximately 2000 B.C. to the 15th century A.D.

The hydration sequence is based on the measurement of 235 flakes and bifaces from 19 sites (Russell 1981). An associated C14 date of 490 B.C. ± 195 at one of the sites, and 11 temporarily diagnostic Chiricahua Cochise, Basketmaker II, and Basketmaker III projectile points produced a single linear hydration rate of 541 years per micron. Russell (1981) used this rate to develop mean hydration dates for each site; according to his calculations, most date from approximately 417 B.C. to A.D. 520. One site has a mean date of A.D. 1331, and another has a mean date of 2078 B.C. Baker (1981) also averaged out the hydration values on a site-by-site basis, and concluded that most date from 2 B.C. to A.D. 438. The present author (Winter 1981b), on the other hand, plotted out the measurements for the artifacts from each site in clusters of .4 microns, since Russell's (1981) analysis had a measurement error of plus or minus .2 microns. The resulting date clusters (Figure 26) indicate that 17 of the sampled sites were used in late Archaic and Basketmaker II times, or from approximately 600 B.C. to A.D. 400. Several were also used in mid to late Archaic times (from approximately 2000 B.C. to 900 B.C.), while seven were visited in the Basketmaker III and Pueblo I periods (roughly A.D. 600 to 900). Only two sites were used in late Pueblo II-early Pueblo III times (both at about A.D. 1169), and they were visited in the Pueblo IV period (approximately A.D. 1330 to 1439). All three approaches therefore indicate a preponderance of use in late Archaic and Basketmaker times, with much less intensive use in slightly earlier and later periods. None of the sites appear to have been visited in the Pueblo V period. The absence of historic dates is not surprising, since ethnographic research at Jemez Pueblo (Weslowski 1981) demonstrated that the Pueblos collect Redondo Valley and Valle Grande obsidian only for societal and ritual purposes. Redondo Valley is important, however, for hunting, plant collecting, and religious activities associated with Redondo Peak.

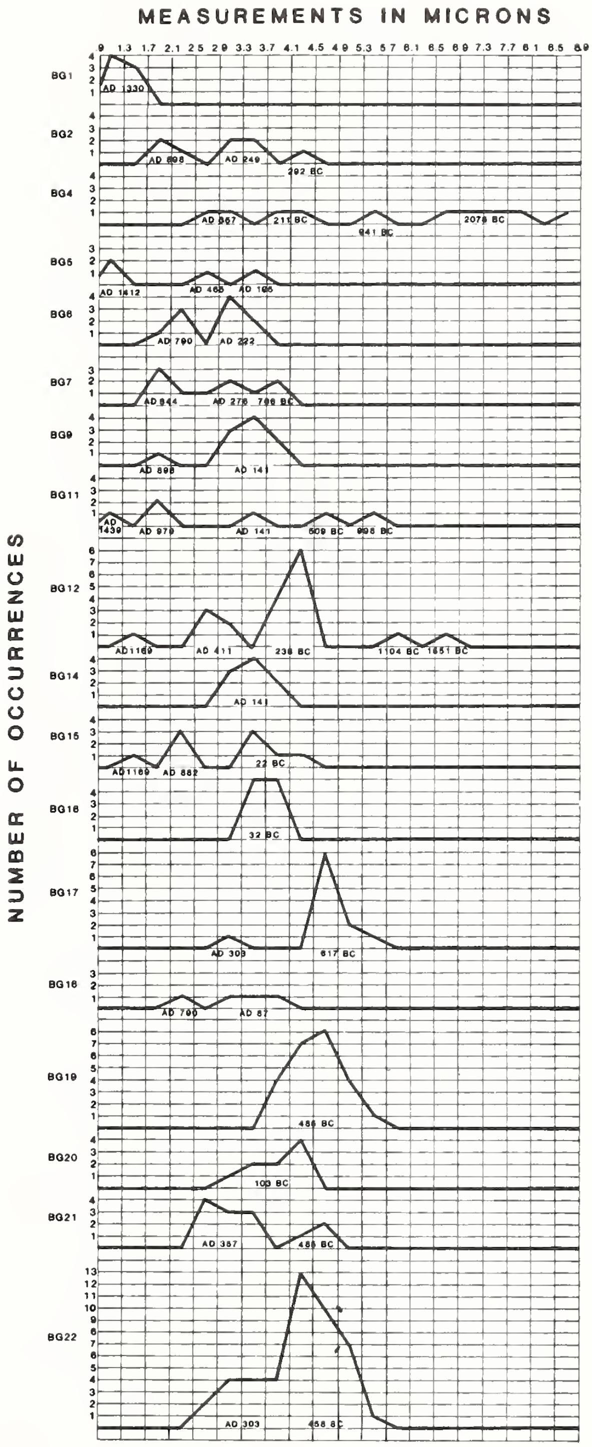

Figure 26. Obsidian Hydration Dates of 18 Redondo Valley Sites.

THE DISTRIBUTION OF JEMEZ MOUNTAIN OBSIDIAN

Jemez Mountain obsidian was used extensively throughout the San Juan Basin and adjacent parts of the Southwest from Paleo-Indian through Anasazi times. Meyers' and Ford's (n.d.) trace element analysis, for example, identified Jemez Mountain obsidian artifacts at a number of PaleoIndian sites. These include Folsom materials from Sandia Cave, Clovis artifacts from the Dailes site near Los Lunas, Cody artifacts from near Laguna, Clovis and Agate Basin items from the Baker site on the West Mesa near Albuquerque, and Clovis and Cody artifacts from another West Mesa site. Wilmsen (in Meyers and Ford n.d.) also traced Folsom artifacts from the Lindenmeier site to the Jemez Mountains, while Broster (this volume) identified Belen and Eden points from Cebolleta Mesa as originating in the Jemez Mountains. Jemez obsidian accounted for 30 percent of Broster's Cebolleta Mesa PaleoIndian artifacts; Grants Ridge, Red Hills, and Polvadera obsidians were also present.

There is considerable evidence for use of Jemez obsidian in the Archaic period. Over 100 late Archaic surface hearths have been found near Santa Ana, in association with numerous lithic materials, of which 20 percent are obsidian. Agogino and Hester (1953) did not source the obsidian, but it is probably from the Jemez Mountains, considering the sites' locations along the Jemez River. Obsidian artifacts are also common in Jemez Cave, which is approximately 10 miles (16 kilometers) down the Jemez from the mouth of Redondo Creek. The cave's preceramic levels have been C14 dated to 490 $\pm$ 250 B.C.

The site was probably used in the spring and fall for the planting and harvesting of corn. Plant gathering and tool manufacturing also occurred at or near the site. On the basis of projectile point types, Ford suggested that the occupants used the Santa Ana lowlands during the winter. Meyers and Ford (n.d.) traced the Jemez Cave obsidian to the Jemez Mountains.

The Arroyo Cuervo region to the west was another area where Archaic foragers used Jemez obsidian, from approximately 5500 B.C. to A.D. 850 (Irwin-Williams 1973). Most of the subsistence round took place within the Cuervo region, but the presence of large quantities of Jemez obsidian indicates use of the mountains as well. Irwin-Williams (1973:15) suggests that only two types of non-local activity sites were used by the Cuervo foragers: "isolated hunting camps in the Jemez Mountains and repeated quarry workshop camps."

Jemez obsidian that was probably from the "Redondo Peak - Valle Grande" was also recovered from several Archaic sites in the Gallisteo Basin (Lang 1977:322). Fifty-four percent of the artifacts from an Oshara site and 35 percent of the artifacts from a later Chiricahua-Cochise site were obsidian, leading Lang to conclude that "the Cochise population . . . possessed less direct or intensive access to the Jemez Mountain . . . obsidian resource than did prior local populations of the Oshara Tradition, presumably linked to like groups of the western montane area" (Ibid).

Jemez obsidian has also been found in a number of early sites in the San Juan Basin, such as in the Navajo Indian Irrigation Project (NIIP) near the San Juan River (Elyea, Abbink, and Eschmann 1979), the CGP and EPCC areas along the lower Chaco River (Reher 1977; Sessions 1979), and at Star Lake (Wait 1976). Fifty-nine of the sites in Blocks 4 and 5 of the NIIP, for example, yielded obsidian artifacts, most of which were bifaces or biface resharpening flakes. Similarly, the EPCC obsidian artifacts were primarily projectile points.

Valles Caldera obsidian was also used throughout northwestern New Mexico and adjacent areas in Anasazi times. Jemez obisidian has been found in sites ranging from Gallisteo Basin in the east and Los Lunas in the south, to Chaco Canyon in the west, and Mesa Verde in the north (Boyer and Robinson 1956; Meyers and Ford n.d.). The Chaco Canyon obsidian is especially interesting, as demonstrated by Elliot's (1980) comparison of 400 artifacts from 20 Chaco Canyon sites with 140 samples from 7 source areas. Over 50 percent of the artifacts were made from Jemez obsidian, compared to 20 percent for Polvadera Peak, 17 percent for Grants Ridge, 13 percent for Red Hill, and a single artifact each from Antelope Wells in southwestern New Mexico, and Cochetopa near Gunnison, Colorado.

Sappington and Cameron (1981) have provided additional information concerning the Chaco Canyon Anasazi use of obsidian. They analyzed over 650 obsidian artifacts from

15 Basketmaker III through Pueblo II (A.D. 500-1200) sites in the canyon, then correlated the artifacts with five regional sources. Jemez obsidian accounted for 59 percent of the total artifacts, and there were important changes over time in its frequency. Less than 14 percent of the pre-A.D. 700 Chaco artifacts were made of Jemez material, while 69 percent came from Red Hills. The use of Jemez obsidian then increased dramatically, accounting for 56-58 percent of the A.D. 700-1020 artifacts, and 80-88 percent of the A.D. 1020-1200 artifacts. Sappington and Cameron suggested that these changes in frequencies resulted from the fact that the Chacoan obsidian procurement strategies were controlled by natural material selection. That is, the Grants and Red Hills obsidians are generally composed of small nodules, while the Jemez Mountain sources yield obsidian that is much more abundant and larger. Thus the Red Hills and Grants artifacts at Chaco Canyon are primarily small cores and projectile points, in contrast to the Jemez artifacts that are generally larger finished tools, such as bifaces and flake tools. Sappington and Cameron concluded that the increase in the use of Jemez obsidian was due to an increase in the knowledge about the abundance, quality, and proximity of Jemez obsidian.

Jemez obsidian has also been found at Anasazi sites elsewhere in the San Juan Basin and nearby areas, but in far smaller quantities than in Archaic times. Sessions (1979), for example, found no obsidian at the EPCC Anasazi sites, while Elyea, Abbink, and Eschman (1979) recovered it from only 25 percent of the NIIP Anasazi sites. Meyers and Ford (n.d.) traced obsidian from the Cuyamunge and Puye Pueblo IV sites to the Jemez Mountains, and Boyer and Robinson (1956) identified Jemez obsidian on Cochiti Mesa, in Rito de Los Frijoles, and at Otowi Ruin, Unshagi Ruin, and Pa-ako Ruin. Thus it appears that Jemez obsidian was traded widely throughout northwest New Mexico and southwest Colorado in Anasazi times, but that it was restricted more to the larger sites or site complexes. It even occurred as far away as Kansas, where it appeared in late Dismal River Aspect sites (Meyers and Ford n.d.).

DISCUSSION

The patterns of distribution of Jemez obsidian and their changes over time raise important questions about the procurement of obsidian, its uses and exchange, and its socioeconomic roles. Sappington and Cameron (1981) briefly addressed these questions with their proposal that the increases in use of Jemez obsidian at Chaco Canyon represent a transition from a general, multi-source procurement system to a sole-source system that involved specialized exchange. They claimed that the major factor in this transition was an increasing awareness of the proximity and abundance of the high quality Jemez source. Other exotic lithic materials, such as Washington Pass, Brushy Basin, and yellow-brown spotted cherts, also became more popular at Chaco Canyon in late Anasazi times. Cameron (1981) concluded that these changes were due to increasing control over source areas.

On a more general level, obsidian may have played a role in redistribution, craft specialization, information exchange, and other forms of economic interaction in the Chacoan culture. Cameron (Ibid), for example, concluded that obsidian and other exotic lithic materials were redistributed among the large sites in Chaco Canyon; she does not believe, however, that there was redistribution between the Canyon sites and the distant "outliers." Powers (1981) proposed that the Chacoan economic system was probably inefficient as a redistributive network for most times, although it was obviously effective in the exchange of exotics, such as turquoise and obsidian.

Cordell (1979a, 1979b) and Cordell and Plog (1979), on the other hand, have suggested that an elaborate exchange and alliance network involving obsidian was a major element of the Chacoan culture. Craft specialization, irrigation, social stratification, redistribution, and the use of turquoise as a medium of exchange were aspects of this culture. Cordell and Plog (1979) have also argued that there was a series of "nested hierarchies" that was ultimately involved in trade with Meso-America. The local level involved specialized sites, family sized villages, and large complex administrative sites, such as those in the Canyon and their outliers. These formed interaction spheres in an alliance network, which involved exchange by local and regional elites. The highest level centers were the Chaco, Mesa Verde, Cibola, and other "cultures," each

of which may have briefly controlled the Anasazi-wide exchange system, and even interacted with MesoAmerica. Each was also very expensive to maintain, with large amounts of labor required for the roads, Great Kivas, irrigation networks, and status items.

Cordell (1979a) has additionally proposed that information specialization was a critical element of this system. Because of variations in natural and agricultural productivity across the San Juan Basin, there was a gradient of the available types of food, from the edge of the Basin where productivity was the highest, to the marginal center where productivity was low and agriculture risky. There was also a corresponding gradient of organization, from the most complex in the center to the least complex at the edges. Thus a regional alliance network was established, with the center receiving food and other resources in return for information about potential conflict with foragers, productivity forecasts, and so on.

Cordell has suggested that obsidian played a role in this system in a number of ways. First, the road network may have been used to transport obsidian, plant resources, fauna, and other materials that were essential for the maintenance of the alliance system. Second, certain of the Chacoan sites were specialized centers for the production of ceramics, obsidian tools, other exotic lithic tools, turquoise items, and so on. Finally, craft specialization, such as the production of obsidian tools, would have enhanced the efficiency of information exchange, and specialty items may have been limited to those in control of the information flow. Common items, in contrast, would have been available to all, in order to avoid competition.

The relationship of obsidian with the development of craft specialization, the emergence of stratification, and increase in population density has also been considered by Santley (n.d.), in his discussion of Late Formative obsidian in the Basin of Mexico. Although it is highly unlikely that there was any direct relation between the obsidian exchange systems of the Basin of Mexico and the Jemez Mountains, a review of Santley's model is pertinent, since similar distributional patterns and underlying causes may have been in operation in both areas.

Based on the distribution of prismatic blades and other obsidian tools at the Formative site of Loma Torremote, Santley proposed that the production of specialized obsidian tools was closely associated with rising social status. During early times, each household in his excavation sample seems to have procured, processed, and used obsidian at roughly the same level of intensity, and they probably had the same access to obsidian sources. In later times, in contrast, one of the households appears to have been a center of blade production. Santley believes that the household's inhabitants had high status, and that their blades were "passed up the status hierarchy in exchange for sumptuary items, or moved laterally in exchange for craft items or raw materials" (Ibid:28).

Inspired by this data and by "empirical generalizations," Stantley developed a complicated model concerning the emergence of craft specialization. First, he calculated that a single, full-time blademaker can provision 2083 consumers per year, since blades are relatively easy to make. In the absence of alternative sources of income, or in situations of periodic agricultural risk, the craftsman would probably have to associate himself with a "nascent elite" patron, who would support the craftsman in return for control over the product.

Next, Santley considered distance a critical factor in the exchange system. Since obsidian tools can be produced relatively cheaply and transported easily, one producer or producing center can serve a large population of consumers over a broad area. In low population density situations demand would be low, and consequently craftsmen would probably work only part time, in close proximity to consumers. In high density situations, where demand is greater, the craftsmen could be fulltime producers, who are centralized in a location that serves a large consumer population. "Economic considerations suggest that lithic working, blade manufacturing in particular, should emerge as a specialized craft activity early in the settlement history of an area, assuming increases in population over time" (Ibid:67).

Still another factor in Santley's model of the development of obsidian craft specialization is labor scheduling conflicts. Scheduling conflicts in low population

density, egalitarian cultural settings may result in short-term specilization, but there is no permanent or long-term specialization within age or sex groups. Low density settings where subsistence risks are great might require a number of backup, short-term specialization strategies, especially in areas of environmental diversity or in frontier contexts, where the number of options will be high. However, even in these situations there will be no permanent specialization, "since variable risk and low population density permit alternative labor arrangements during succeeding years" (Ibid:72).

Craft specialization evolves, Santley suggested, when population increases limit group mobility and reduce the available subsistence options. Certain options are eliminated , while others, such as hydraulic farming, are intensified to protect against subsistence risk. These adjustments produce scheduling conflicts, competition over land, and wealth imbalance. Santley proposed that it is at this point that economic stratification emerges, and that the craftsman-patron relationship develops. The craftsman benefits by obtaining a patron's support, and the patron benefits by his control over the craftsman's products, which are visible manifestations of the patron's power and stockpiles of energy for exchange in lean years. "In a high risk environment, this development will occur under relatively low population density conditions, but in areas where the degree of crop security does not vary dramatically or where the possibility of double cropping exists as a real alternative, larger populations more densely distributed over the landscape will be required" (Ibid:75).

The location of source areas is another factor in Santley's model. As demand for obsidian increases and source areas or nearby localities are colonized, large quantities of obsidian will move through critical nodes, which results in more revenue and increased stratification for those in control of the flow. Competition is also increased, and sociopolitical organization and trade systems become important mechanisms for obtaining obsidian, especially for the consumers who are distantly removed from the source. When developed sociopolitical organizations appear near the sources, they are at a distinct locational advantage, and their elites are now in a position to restrict access to raw materials.

Several other analyses of New World obsidian exchange networks provide comparative data and concepts. Early and Middle Classic Maya obsidian, for example, was not distributed randomly among the lowland sites, and it was generally restricted to non-utilization contexts, such as rituals and social stratification (Sidrys 1977:100). It may even have functioned within a system of "political potlatching," with large quantities of obsidian artifacts intentionally cached during public rituals at the lowland ceremonial centers. These sites were also important nodes in the highland/lowland obsidian exchange network.

In Post Classic Mayan times, in contrast, obsidian became a common utilitarian item. Sidrys suggested that "a radical reorganization of obsidian import" caused this devaluation as the evolution of sea canoe transportation increased the availability of obsidian. The development of neutral "ports of trade" was a major factor in the emergence of sea routes. Another possibility is that local fishermen served as middlement in the exchange system. In Post Classic times obsidian was used primarily in coastal or riverine sites, in contrast to the Classic period when it was most popular in the ceremonial centers (Ibid:100, 103-104).

Two studies of California obsidian trade are also relevant, especially since they deal with apparent egalitarian networks and highland sources. Despite the absence of centralized sociopolitical organizations in California, Ericson (1977) proposed that the development of exchange networks facilitated an extensive integration of independent tribelets and resources. Obsidian from at least 10 sources was supposedly a key element in this exchange system. As shown by Ericson's three-dimensional syngraphic mapping of obsidian distribution, there is no evidence of hierarchical centers in California, "which would be represented by abrupt, localized anomalies within the regional pattern" (Ibid:113), such as those that Sidrys (1977) observed around Classic and Post Classic Mayan sites. Instead, the areas of greatest occurrence of obsidian are around the sources, and then the quantities fall off in percentage value. They do not decrease symmetrically, however, and

instead they decrease in gradients that may be related to trail locations.

Ericson (Ibid) used these findings to develop a locational model of obsidian exchange. Since California obsidian was generally used as a utilitarian item in egalitarian societies, Ericson argued that the quantity of obsidian in the exchange systems should have been relatively constant, and that it would have been related directly to the number of consumers. As obsidian passed through the system from the upland "supply zones" to the lowland "contact zones," its quantity would have decreased in direct proportion to the increase in the number of consumers. Thus the amount of obsidian would decrease with distance from the source, unless the exchange system adjusted the quantity by increasing production at the source or by restricting use to certain tool types (Ibid:120).

The analysis of the tool types and debitage at one California source area (Bodie Hills) demonstrated that the amount of obsidian artifacts in the exchange networks did in fact change over time and that only certain types of tools were made (Singer and Ericson 1977). Unfinished bifaces and complete prismatic blades were produced at the site, then distributed within distant consumer areas in central and southern California, primarily from 2000 B.C. to A.D. 500. Singer and Ericson (Ibid:187) calculated that from 960 to 1725 bifaces and blades were produced each year at the site, which represents a casual, seasonal activity, since only 48 to 86 man-days of work would be required to produce that number of artifacts. They also suggested that the decline in use of the Bodie Hills source after A.D. 500 may have been related to population expansion and movements in California and the Great Basin, and to the increased use of other obsidian sources and alternate types of lithic material.

Brown's (1981) study of Late Sinagua obsidian exchange in central Arizona is also relevant, particularly since he dealt with a southwestern situation that was generally contemporaneous with, and of the same apparent magnitude as the Jemez-Chacoan system. Brown compared the occurrence of Government Mountain obsidian in sites around the source area, with its frequencies in more distant sites, such as the large settlements on Anderson Mesa and at Chavez Pass. He concluded that hierarchical centers were not present, but that there were at least six exchange centers in a "down-the-line" trade system in which obsidian was an uncontrolled, non-prestige item that was available to all.

The "down-the-line" obsidian exchange model was developed by Renfrew (1977) to explain the distribution of obsidian in the Near East. Renfrew assumed that "in the absence of highly organized directional exchange, the curve of frequency or abundance of occurrence of an exchanged commodity against effective distance from a localized source will be a monotonic decreasing one" (Ibid:72). Several types of fall-off lines might be expected in a down-line system, depending on whether the reduction in numbers of a material during any one transaction is proportional to the number left, whether it is independent of the number left (and dependent on some other factor, such as distance from the source), or whether random, uncoordinated transactions are involved. Down-the-line transactions also vary between supply zone and contact zone situations. In the former " . . . the user is traveling directly to the source or manufacturing center, or the producer is traveling with his goods directly to the purchaser. The result is an extreme localization in the distribution of the product that is not in general handed on in subsequent transactions" (Ibid:84). Contact zone behavior, in contrast, results when commodities are exchanged beyond the boundaries of the supply zone (Ibid:84-85).

Although there are important differences between the various types of down-the-line exchange, all share in the fact that the amount of material in the system falls off regularly as distance is increased from the source. These kinds of exchange are also similar in that the transactions are occurring in a "homogeneous" culture, i.e., one in which all individuals or communities are allowed to freely participate in the transactions.

This situation contrasts markedly with "directional exchange," in which there are restrictions in the exchange of certain materials, and/or in the number of people who are allowed to receive them. The goods are exchanged preferentially, with the result that the curves of frequency of occurrence of an exchanged commodity with regard to distance from a source will be

non-monotonic. Directional exchange is associated with central places which are loci of exchange activities where more of a commodity per capita travels through them than in smaller, lower order localities. According to Renfrew:

> The hierarchy of settlement is here accompanied by a hierarchy of exchange activity. Suppliers from a distance bring their goods first to the central place, and they are disseminated from the central place to smaller localities. In other words, the central place is used for break of bulk. The effect here is that, in terms of supply, the central place is nearer to the source than are lower-order localities supplied by it, even if these may in reality be geographically closer to the source.
>
> If the archeological record is formed in proportion to the quantity of material handled, the central place will show a greater frequency than its population alone would warrant, since it is acting as a supply center for its hinterland (Ibid:85).

Even greater quantities of material will accumulate per capita when a hierarchy of persons accompanies the hierarchy of places as important individuals with preferential access to the commodity accumulate more of it.

A GENERAL MODEL OF OBSIDIAN EXCHANGE

The preceding discussion summarizes a number of concepts that can be used to construct a general model of obsidian exchange. Although the Mexican, Guatemalan, Californian, and other models are based primarily on field-generated induction and logic, and not on experimental observation, they nonetheless allow the development of a set of hypotheses that can deductively be tested against the New Mexico data. If the hypotheses generated by this model are correct, then the Jemez Mountain and other New Mexico evidence should fit certain expectations. The general model and its expectations are briefly discussed below, followed by a test of the data fit and a discussion of results. Readers are directed to the preceding discussion and to the papers by Santley (n.d.), Sidrys (1977), Ericson (1977), Singer and Ericson (1977), Brown (1981), and Renfrew (1977) for more details.

At the most basic level, the prior studies have suggested that the procurement, modification, and use of obsidian were important activities for many cultures. Since it is a relatively rare and useful item, obsidian formed a key element in the socioeconomic organizations of these cultures, and thus elaborate exchange systems were developed to procure and control it. These networks were carefully maintained and adjusted when necessary to meet fluctuations in demand and minor alterations in the larger economic environments. Obsidian exchange networks were also vulnerable to cultural change, so alterations in regional exchange systems often resulted in major changes in the use and trade of obsidian.

In homogeneous (e.g., egalitarian) cultures, all groups and individuals generally have unrestricted access to the procurement, modification, and use of obsidian. Only environmental factors, such as excessively long distances to sources, no available sources, or intervening hostile societies, limit their access. Because of the cultures' non-hierarchical natures, obsidian is primarily used for utilitarian purposes, and there are no full-time craftsmen, patrons, elites, centers of control, stratification, or related factors that limit accessibility. Obsidian can be procured, converted into tools, and transported relatively easily, and population density and demand are generally relatively low, so usually the tools will be produced on a part-time basis, and the procurement/production sites will be used only sporadically. In rare instances production and exchange centers might develop in areas of relatively high population density, but because of the homogeneous nature of the society, obsidian will still be a non-prestige item that is available to all.

The average consumers in an egalitarian economy can obtain obsidian in one of two ways. First, they can travel to the source areas and obtain it directly, since there are no limitations to their mobility or to their access to the sources. Second, if distances are too great or if for other reasons they decide against direct

procurement, they can obtain it through exchange, via friends and relatives, trade partners, reciprocity, etc. The resulting down-the-line exchange network will channel obsidian from procurement areas at the sources, which are generally at high elevations, to the distant consumer areas, and the only criterion governing the amount of obsidian flowing through the system will be consumer demand and the quantity available. Territorial and linguistic boundaries will generally not affect the flow, unless neighboring groups are involved in directional trade and/or they are hostile. Since the amount of obsidian in the network decreases with distance from any one source, sites closer to the source will normally have more obsidian artifacts than more distant sites. Sites along major trails leading into consumer zones may also have relatively larger amounts of obsidian than adjacent sites, and distance from trails will be reflected in the amount of obsidian at sites. As new consumers are added in distant areas, procurement and production will be increased to accommodate the increased demand. The flow will also probably involve finished or near finished tools, such as bifaces, with processing occurring at or near the sources, in order to cut down on transportation costs and to meet demand. Finally, the use of any one source area will decline as its obsidian is depleated, or as higher quality and/or more accessible sources are discovered. Even low quality, low quantity sources will continue to be used, however, as long as demand outstrips the amount of available high quality material. Also, even low quality, small nodules might prove adequate for certain tools, especially when high quality sources are in distant locations.

Directional obsidian exchange networks, in contrast, are based on limitations in access to raw materials and in the production and use of a rare and valuable commodity. Obsidian can be a crucial element in stratification and other aspects of hierarchical societies. The flow of obsidian is controlled at the source, by limiting accessibility, and/or at key points or nodes along the network, through caching, redistribution, rituals, markets, etc. Part- or full-time craft specialization in the production of obsidian tools in centralized production localities is also usually an important element of directional exchange networks, as it ensures that the patron, sponsor, elite or whomever, who supports the craftsman has control over the product. The distribution of obsidian in directional trade networks is generally restricted to high status, non-utilitarian contexts, with obsidian artifacts often taking the form of blades and bifaces. Utilitarian forms will also sometimes occur, but the value of obsidian as a status symbol and as a form of wealth that can be stockpiled for future exchange takes precedence over everyday use and increases its cost beyond the reach of most non-elites.

Since exchange places are important locations for controlling the flow of obsidian, the establishment of these centers generally correlates with increased stratification, wealth imbalance, competition, and sociopolitical organization. A developed sociopolitical organization is especially important to assure consumer access to finished products in locations distant from the sources, and in areas at or near the sources such organizations can be very powerful mechanisms of controlling the flow and limiting access. They can also lower production costs, so that the resulting profits can be routed into increased production or lower prices, which in turn can be used to undercut competition.

Down-the-line (non-hierarchical) and directional (hierarchical) exchange should result in identifiable differences in the frequencies and contexts of occurrence of obsidian at the archeological sites where the exchange transactions took place. Assuming that the artifacts were deposited in proportion to the numbers of items in the exchange system, the following expectations should be met.

<u>Down-the-line exchange</u>

1. Obsidian artifacts of a particular type should decrease in frequency as distance increases from the source area. Sites that are closer to a source should have higher frequencies while distant sites will have much lower frequencies.

2. Distant exchange centers, and sites along trails, may have a greater abundance of obsidian than nearby, smaller sites, but their frequencies per capita should be the same.

3. All obsidian artifacts should be a

utilitarian nature, and there should be no evidence of prestige items, ceremonial caching, and related hierarchical behavior.

4. Production or reduction sites will generally be located at or near the sources. Distant, consumer sites should contain finished or nearly complete items.

Directional Exchange

1. Obsidian of a particular type will not decrease in a regular fashion as distance from the source is increased; rather, it will cluster at sites that may be at great distances from the sources.

2. Centers of control for the flow of obsidian will be represented by higher frequencies per capita than at nearby sites.

3. Obsidian will occur primarily in non-utilitarian contexts, and it may take the form of prestige items and be cached ceremonially.

4. Production may not necessarily occur at or near the source, and raw obsidian may occur in distant sites where there is evidence for storage, modification, and preferential distribution/use.

5. Many potential source areas and quarry/ workshop locations will not be used, and those that are may have evidence of administrative-related activities, such as the storage of food stuffs and exchange items, habitation, etc.

OBSIDIAN EXCHANGE IN NEW MEXICO

How well do the New Mexico obsidian data fit these expectations? Obviously it is too early for a final judgment, since the frequencies of occurrence of different types of obsidian at most sites in New Mexico have not been calculated or published. Also, certain of the distributional patterns that are visible, such as at the Redondo Valley sites, could undoubtedly be interpreted differently. Still, it is apparent that the Redondo Valley, San Juan Basin, and certain other data do seem to behave according to the expectations of the preceding models, and there are general indications that both a down-the-line and a directional exchange system are represented by the obsidian distribution patterns. These patterns include the following.

1. Of the 18 Redondo Valley sites that have obsidian hydration dates, 17 were visited in late Archaic and Basketmaker II times, two date to an earlier period, and seven have Basketmaker III and Pueblo I period dates. Only five sites were used in Pueblo II-III and Pueblo IV times. Thus site visitation dropped off dramatically after Basketmaker II times, and it is obvious that the peak period of use was during eras that are generally assumed to represent hunting and gathering and simple agricultural economies. Such an intensive pattern of early use would be expected in a generalized economy when access to, and use of obsidian were unlimited and open to all.

2. All of the Redondo Valley sites are apparently workshops where bifaces and other finished tools were produced from Valle Grande obsidian. Incidental hunting and plant gathering also occurred at or near the sites, but it is obvious that the major activities that occurred at the sites were associated with the procuring of obsidian and the production of tools for export. The large number of early sites near a source area, and the evidence for tool production, meets the previously discussed down-the-line exchange expectations.

3. Jemez Mountain obsidian that is probably from the Valle Grande occurs relatively frequently at numerous early sites in the San Juan Basin and adjacent areas. There is no evidence for hierarchical centers and nodes of distribution or storage, and the artifacts were primarily projectile points and other finished utilitarian tools.

4. A variety of other types of obsidian also occur in early sites in the San Juan Basin and nearby areas. Broster's (this volume) and Sappington and Cameron's (1981) data indicate that Jemez obsidian was only one of a number or types that were used, which suggests that the PaleoIndian and Archaic exchange networks were generalized, multi-source systems.

5. Jemez obsidian was still used in the San Juan Basin in later Anasazi times, and in fact by A.D. 1020 it accounted for 80 percent of the obsidian in Chaco Canyon, while other material types had declined dramatically. As Sappington and Cameron

(1981) have observed, this indicates a change from a generalized, multi-source procurement system, to a specialized, sole-source system. They also proposed that this development was the result of an increasing awareness of the quality and abundance of the obsidian in the Jemez Mountains. However, it could also have resulted from the establishment of control over the Jemez source, and the elimination of competition.

6. Jemez obsidian also occurred at certain Chacoan outliners, at Mesa Verde, and at other large sites, but it was relatively rare at small sites. This anomalous distribution is suggestive of hierarchical centers, and preferential availability.

7. The Redondo Valley workshops were still visited in late Basketmaker III and Pueblo times, but far less frequently. The presence of large quantities of Jemez obsidian in Chaco Canyon, and the fewer sites in Redondo Valley suggest that access had been limited to the Valle Grande source area and the workshops. Also, production may have shifted from the "supply zone" to specialized crafting areas in the Canyon.

8. In addition to the few sites in Redondo Valley that have Pueblo II-III dates, there are a number of Anasazi sites in the Valle Caldera that are suggestive of relations with the San Juan Basin. Hewett, for example, noted that "the existence of other important exceptionally well preserved ruins has been reported from the high Valle Grande and San Antonio Valley" (1906:51). More recently Bussey examined ceramics and corn from caves in the Sulphur Springs and San Luis Creek areas of the Valles Caldera (Whitforn and Ludwig 1978). He concluded that they were used until A.D. 1100-1250, and that they were occupied year-round by farmers who hunted and gathered and traded obsidian. Bussey's conclusions about year-round use and farming are probably incorrect, considering the elevation of the Valles Caldera, but the presence of pottery and corn cobs are nonetheless interesting. These sites could have been small administrative centers that controlled access to the Valle Grande obsidian source.

9. Evidence for post A.D. 1300 Jemez-era obsidian exchange is limited to several sites with 14th century hydration rates in Redondo Valley, and to obsidian from Cuyamunge, Puye, and several other Pueblo IV sites on the east side of the Jemez Mountains. The Jemez Pueblos use obsidian only for societal and ritual purposes, although Redondo Valley is a valuable hunting, plant gathering, and religious location. The Jemez also claim that they colonized the Jemez Valley in the 14th century, after having moved into the region from the northwest (Weslowski 1981). Thus the decline in the use of obsidian and the altered exchange patterns would be expected after the collapse of the Chacoan exchange network in the 12th and 13th centuries, and the development or substitution of a different socioeconomic organization, in which obsidian was a minor and relatively unimportant item.

In summary, the northwest New Mexican obsidian data tend to support a general model of exchange in which obsidian changed from an unlimited item in a down-the-line network to a controlled commodity in a directional system. This change could have occurred as a result of the emergence of a hierarchical socioeconomic organization. After A.D. 1300 and the collapse of the Chacoan economy, the role of obsidian again changed, and in historic times its acquisition and use has been restricted to societal and ritual contexts.

Obviously obsidian exchange was only part of a larger socioeconomic system that changed radically between the PaleoIndian, Archaic, Anasazi, and historic Pueblo cultures. The possible role of obsidian in these larger systems is discussed in the following hypothetical reconstruction.

PaleoIndian

Jemez and other forms of obsidian were definitely procured by PaleoIndians in New Mexico and Texas, but workshops and quarries have yet to be identified in the Jemez Mountains. Russell (1981), however, did note that four of the 235 artifacts that he measured from Redondo Valley had hydration rind thicknesses of 33.3, 32.6, 22.3, and 14.0 microns, which date to 16,035, 15,657, 10,084, and 5594 B.C. respectively, based on his hydration rate of 541 years per micron. He did not use these measurements in his calculations, since other edges on the artifacts had much thinner rinds, but he did suggest that they represent culturally or naturally modified artifacts that were reused in Archaic and

more recent times.

The lack of quarry/workshops and the relatively rare occurrence of Jemez obsidian in PaleoIndian contexts suggest that the local PaleoIndian obsidian exchange network, if it can be called that, was poorly developed and of little consequence. It also appears to have been localized in the Rio Grande Valley and its tributaries, and most of its obsidian artifacts, such as those at the Los Lunas and West Mesa sites, were probably made from local alluvially deposited Jemez obsidian, rather than from nodules that were obtained from the Valle Caldera. It may also be that there was no formal obsidian exchange, and that each mobile group procured its varied lithic materials as it passed through or near source areas in pursuit of big game. The Valle Grande in particular would probably have been an ideal hunting area, and the local obsidian procurement may have been an incidental activity that occurred in association with hunting and gathering.

Archaic/Basketmaker

The broad spectrum, hunting and gathering and early farming peoples of New Mexico apparently developed a down-the-line obsidian exchange system that was embedded in a non-hierarchical economy. Certain authors, such as Wait (1976), have proposed that the northwestern New Mexican Archaic groups were organized in territorial bands with minimal seasonal movements. Each band moved no further than a few kilometers between winter settlements in the pinyon-juniper zones and summertime lowland camps, with permanent populations that remained stable during the seasonal shifts. In fact, Wait argued that long distance band movements were impossible, since they would disrupt the social network and increase the chance of failure due to unpredictable events. He also believed that Archaic bands lacked the organization to deal with the information flow required for long distance movements.

The present author, in contrast, has proposed that a territorial band model is inappropriate for the San Juan Basin Archaic, particularly in marginal environments such as the lower Chaco or Redondo Valley, where flexible productive techniques and organizational strategies would have been required for survival (Winter 1980, 1981b). It is even possible that the same diffuse Archaic populations that exploited the lower Chaco, Star Lake, and other areas of the San Juan Basin also used Redondo Valley and/or other parts of the Jemez Mountains, through long distance movements and regional trade. While the more "optimal" zones such as Star Lake may have been frequented more often than the marginal locations, both areas may have been part of the same region-wide Archaic settlement-subsistence system. The limited technology and the harsh environmental conditions would have precluded fixed "band" memberships and "territorial" boundaries. As with most of the historic foragers of the Great Basin (Steward 1938), the groups may have had flexible memberships, with their economic and social relations forming a broad network of associations that was constantly in flux as various families or other groups moved into different localities in search of sparse resources. Each nuclear family and family cluster would have been interlocked with others in a network of marriages that extended to the geographic limits of the population, with affinal and consanguinal bonds providing the "knots" to the net.

If this reconstruction is correct, then the regional Archaic socioeconomic system would have been as important as the local one in facilitating the use of Redondo Valley. The Archaic occupation of the valley could not have occurred without a broader regional organization that supported the visitors when they were in other locations, as well as when they were in the valley.

Smith's (1976a, 1976b) extended network exchange model provides some implications about the possible organization of the regional Archaic population. In extended network systems, each local centralized unit, be it a nuclear family, household, microband, macroband or whatever, has multiple links to equivalent units with which energy is exchanged. People, food, lithics, information, and other forms of energy move along the network formed by the linkages. Nodes do not become hierarchically dominant, and no regional integration beyond the network of equivalent units is developed.

The location of central places and the flow of energy among them are crucial elements of the regional organization. People move from place to place as individuals, families, and larger groups change their

locations. People also move from group to group as new families are developed through marriage, group membership fluctuates, friends and relatives are visited, task parties gather resources, and so on. Food moves through the network as it is gathered, processed, consumed, exchanged, and otherwise modified in a variety of locations. Lithics, other raw materials, tools, clothing, and to a certain degree information are treated in a similar manner. Since markets, currency, and related commercial features are absent from extended network systems, exchanges are direct, between two or more equivalent individuals in face-to-face contact. If a critical resource is scarce or is spatially or temporarily unpredictable, it will be widely exchanged among many local units. Food, lithics, information, and even people (e.g., potential mates) can be the scarce, unpredictable resource. Scarce resources provide important integrative roles, and define the bounds of the system.

The presence of Jemez obsidian bifaces and other finished tools in Archaic contexts throughout northwestern New Mexico suggests that obsidian was one of the scarce resources that defined the bounds of the regional Archaic system. Sites such as the flake scatters in Redondo Valley and elsewhere in the Valle Caldera could have been the workshop areas for the production of valuable tools that were transported and/or traded extensively through the San Juan Basin and adjacent areas. Although high quality obsidian is very abundant in and around the Valle Caldera, it is nonexistant elsewhere in northwest New Mexico, with the exception of the Grants area, where a similar pattern may have been operating. The range of hydration measurements and the nature of the Redondo Valley sites suggest that the use of the valley was sporadic, and that it occurred for very short periods over a duration of several thousand years. Supplemental hunting and gathering most likely occurred while the Indians were in the valley, but the primary reasons for visiting the area were the acquisition of obsidian and the production of bifaces. Based on the quantity of debris left at the sites and the pattern of hydration measurements, it appears that the visits were infrequent, and that enough bifaces could be produced during any one visit to provide an adequate supply for a number of years of use.

Anasazi

By A.D. 1020 and the development of the Chacoan Anasazi culture, the role of obsidian in the regional economic system appears to have evolved from an unrestricted, utilitarian item that was available to all for the taking, to a controlled substance whose acqusition, production, and/or use was limited. This development would explain the lack of sites in the Redondo area, since fewer individuals or task groups would be allowed to gather the material. Also, if access to source areas was restricted, associated activities such as elk hunting and plant gathering would have been less likely to occur in the valley. Finally, the extensive occurrence of obsidian throughout a relatively vast geographic area, with a high incidence in Chaco Canyon compared to outlying areas such as the lower Chaco and NIIP areas, could be accounted for by the fact that it was now a rare commodity that had taken on special value as a trade item.

A major factor in this change of value and availability of obsidian could have been the evolution of the regional economic system from the simple extended network form of Archaic times to a more complicated form, such as in a bounded, solar, or dendritic central-place system. Although there are important differences in these three forms of exchange, all are based on the restricted control of one or more scarce resources (Smith 1976a, 1976b). It may be a means of production, such as arable land, or an essential food, such as meat, that cannot be locally obtained or produced in sufficient quantities. Since the inequality in access to the resource must be maintained for the system to function, stratification is institutionalized through directional exchange in which the elites control the nodes and means of exchange.

As in earlier Archaic and Basketmaker times, it is likely that the acquisition of obsidian in Redondo Valley was linked with the regional economies of the nearby San Juan Basin and associated regions. Chaco Canyon and its outliers, in fact, may have been important nodes in the obsidian exchange system, which involved redistribution, social stratification, craft specialization, information exchange, and the use of obsidian as a valuable commodity.

Historic Pueblo

The procurement and use of Jemez obsidian declined dramatically after the collapse of the Chaco Anasazi culture and the emergence of the ancestral Rio Grande and related Pueblo groups. It was still used in the 14th century, as shown by hydration dates from several of the Redondo Valley sites, but by historic Jemez Pueblo times its use had been relegated to societal and ritual activities. Thus the historic Pueblo obsidian exchange system was poorly developed and of little consequence, despite the fact that Redondo Peak and the associated valleys of the Valle Caldera were (and are) important hunting, gathering, grazing, and religious locations.

CONCLUSIONS

The distribution of Jemez Mountain obsidian at 21 workshops in Redondo Valley and at numerous sites in the San Juan Basin and adjacent areas reflects the existence of exchange networks from PaleoIndian to historic Pueblo times. These networks linked the highlands, which were exploited on a short term, resource specific basis, with the permanently occupied lowlands. The PaleoIndian and historic obsidian exchange systems appear to have been poorly developed and localized. The PaleoIndian system was centered in the Rio Grande Valley and its tributaries, and much of the obsidian was probably collected from alluvial deposits in the Rio Grande benches, or during hunting trips in the Valle Caldera. The historic Jemez Pueblo obsidian exchange network was limited to the collection and use of Valle Caldera obsidian for societal and ritual activities. Only three of the Redondo Valley sites date to Pueblo IV times, when the system was probably developing after the arrival of the Jemez Pueblos in the upper Jemez Valley.

The Archaic obsidian exchange network, in contrast, was an organized, down-the-line system that was apparently embedded in an egalitarian economy. The majority of the Redondo Valley workshops date to this period. They were probably used for the production of bifaces and other tools for export to the lower Jemez, middle Puerco, San Juan Basin, and nearby areas, where Jemez Mountain obsidian artifacts occur in low frequencies at numerous sites. Other obsidian sources in addition to the Jemez Mountains were used, access to source areas was probably unlimited, and the production and use of finished tools were uncontrolled. Since it was a rare and valuable item, obsidian apparently played an integrative role in Archaic society, and its exchange may have defined the bounds of the local cultural system.

Although the Redondo Valley workshops were rarely visited in Anasazi times, Jemez Mountain obsidian was the most popular obsidian type used by the Chaco Anasazi. This apparent contradiction can be explained by the likelihood that its procurement and the production of tools were now controlled, and limited to craftsmen who worked in lowland production centers. Finished obsidian tools were still probably utilitarian items, but their value as symbols of wealth and as trade items meant that they were commodities in a directional exchange system. In order to control this system, the Chaco Anasazi limited access to Redondo Valley and the Valle Caldera source areas, and almost completely eliminated the use of other sources.

PALEOINDIAN ADAPTATIONS TO HIGH-ALTITUDES ON CEBOLLETA MESA

John B. Broster

An archeological sample survey of proposed timber sale areas was conducted from July 8-November 19, 1979, on Cebolleta Mesa within the boundaries of the Pueblo of Acoma (Figures 27-28). During the course of this survey, numerous PaleoIndian projectile points and other tools were encountered in areas which suggest primary deposition. This chapter attempts to give a general description of these PaleoIndian materials and relate them to their ecological setting.

The Cebolleta Mesa area is geologically a part of the southern San Juan Basin, and contains about 110 square miles (285 square kilometers) of land surface. The entire Acoma Embayment, of which the mesa is a small part, probably dates as early as the Pennsylvanian period. Intermittent sedimentary deposits dating from the Triassic through the Cretaceous form the land mass which accounts for the current regional topography. Tertiary and Quaternary volcanic flows have developed a basalt cap for a large portion of the region.

Cebolleta Mesa is situated on the southern end of the Acoma Embayment some 20 miles (32 kilometers) south of the present City of Grants, New Mexico. This sandstone mesa is capped with a volcanic lava flow which was probably formed by the Mt. Taylor eruption. Numerous lakes or playas on the eastern and southern surface of the mesa are most likely the product of spatter cone formations or collapsed lava cone tubes. These lakes or depressions range from a quarter of a mile long (.4 kilometers) to only a few hundred feet (60 or so meters) in length. There are approximately 80 to 100 of them located within the confines of the mesa, and they were probably the most critical factor in the utilization of the mesa by PaleoIndian populations.

The survey consisted of a 30 percent sample of all potential commercial forest areas on the mesa. The sample was comprised of 22 survey blocks containing 3520 acres (14 km2) of timber land. The sample unit used in this survey was the quarter-section, a section containing 160 acres (.65 km2).

Each of these sample blocks was surveyed by crews varying in size from three to seven people. Corners and boundaries of the sample unit were first flagged to allow easy visibility. The units were then surveyed by crews walking in a line and spaced approximately 66 feet (20 meters) apart.

The basic unit of observation was considered the artifact and all analytical units were measures of variation in artifact density. Thus an isolated artifact was accorded the same value as a large archeological site.

A total of 31 projectile points were of PaleoIndian age, with 23 of these located within or around Rincon Hondo on the eastern side of the mesa. This rincon is the major access to the top of the mesa from the southeast, and overlooks vast areas of rolling plains to the east. Elevations range from the bottom of the rincon at 7440-7900 feet (2267-2408 meters) at the top. Material found at the bottom, along the talus slope, and around the mesa edge dated from Clovis to Cody complex times. The remaining eight projectile points were found on the mesa in association with the playas or on overlooks, which command broad views of several of the lakes.

Additionally, five scrapers were recorded which were of PaleoIndian origin, probably Folsom, with four of them located within the Rincon Hondo area. The remaining scraper was found on an overview on top of the mesa. Four of these tools were found in association with later material and may be reused artifacts.

The following is a description of the PaleoIndian materials encountered during the sample survey.

CLOVIS

The Clovis projectile point is a distinctively large lanceolate fluted biface. The sides are generally straight to slightly convex with a concave base. The point was produced by percussion flaking with pressure flaking used to thin the blade margins. The base and lateral edges are

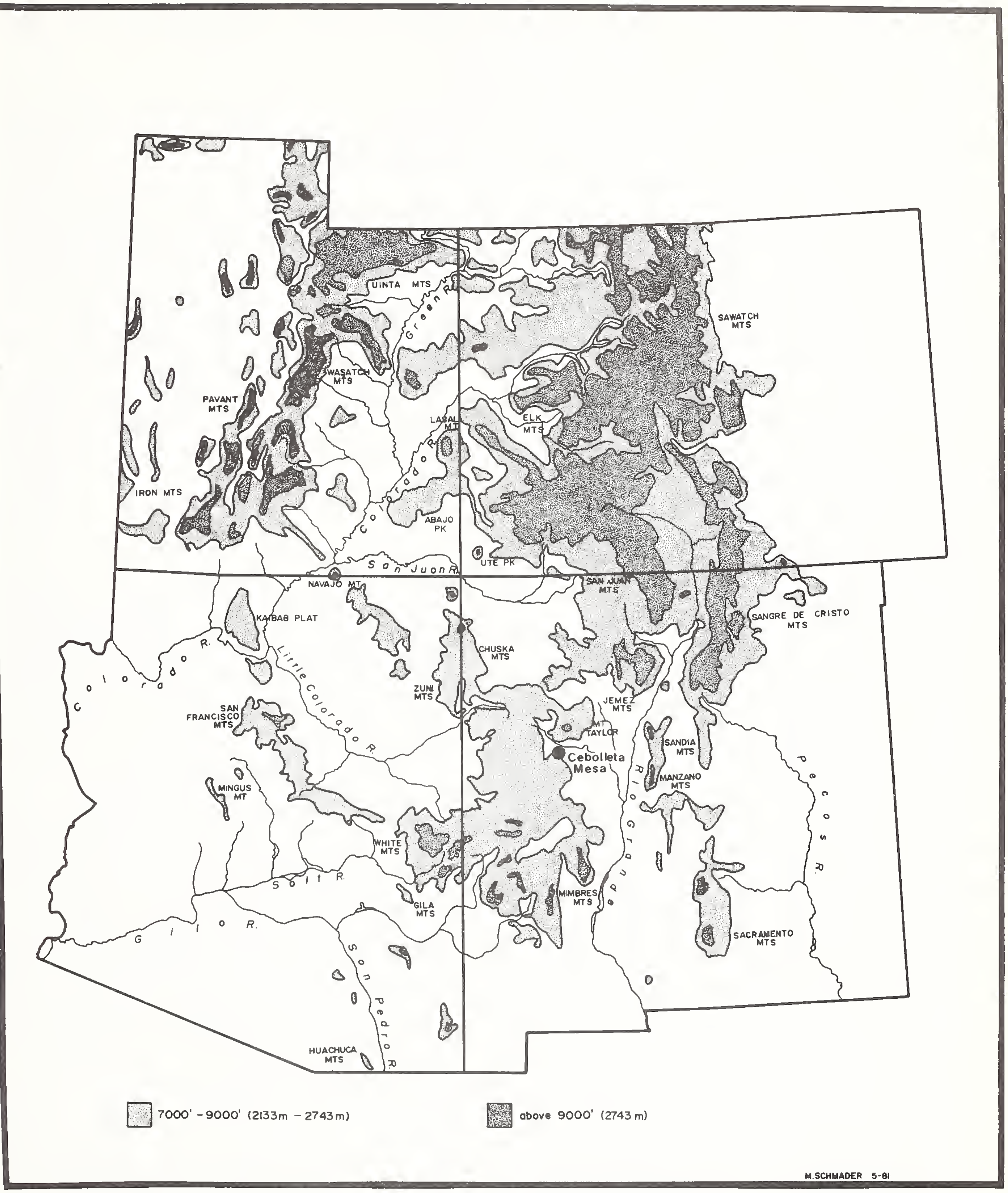

Figure 27. The Cebolleta Mesa Survey.

Figure 28. Cebolleta Mesa: Acoma Timber Sale Survey Project.

usually heavily ground, with one or both sides of the point being fluted. It is believed that the flute was produced by indirect percussion.

The one specimen recovered on the mesa consisted of a basal fragment made from Polvadera obsidian. Only about half of the base was represented, with one of the basal ears missing. Additionally, the point had been reworked into a scraper. Although Clovis occupations have been dated between 9500 and 9000 B.C., care should be used in assigning this date to the site on which the point was recorded. Additional types found on this particular site encompassed a rather long time span. Two Midlands, one possible Belen, one Eden, one Armijo (Archaic), and one Late Archaic point were also encountered on this site. All of the PaleoIndian projectile points from this location have been reused as knives or scrapers, and may represent the curation of these items by later groups.

FOLSOM

The data from a Folsom occupation on Cebolleta Mesa is much more extensive, with 10 projectile points and five scrapers being represented. These items were found on four sites and two isolated occurrences, and three others were isolated artifacts.

The Folsom point is lanceolate in shape with a concave base (Figure 29). The bases have very pronounced ears, with fluting generally on both sides of the point. Extremely fine marginal retouch is a characteristic of the Folsom point. Folsom artifacts have been found in association with Midland projectile points and have been dated between 8800 and 8000 B.C. These points are often found with Bison antiquus, although antelope, canids, and rabbits were recorded within the Folsom levels at the Lindenmeier site in Colorado (Wilmsen 1974).

Nine of the Folsom points and four of the scrapers were found within two adjoining survey blocks in and around Rincon Hondo. The materials were located on the mesa edge, mesa sides, and within the valley floor of the rincon. The locations of some of the artifacts are suggestive of a possible animal jump or trap type kill site or sites. Several playas are in the immediate vicinity of the mesa edge and game could have been driven from them over the mesa scarp. The higher percentage of points to scraping and cutting tools suggests that this area was the scene of several kills of large herd animals.

Two of the Folsom points were actually broken in manufacture. One was located on the mesa edge above the rincon in association with three probable PaleoIndian scrapers as well as later materials. The other was in a side drainage of the rincon. Broken preforms such as these are usually associated with maintenance activities at an armament site (Judge 1973), and they may represent the post-hunt task of repairing broken hunting equipment. The steep edge angles on the scrapers demonstrate use on a hard substance, possibly dense wood or bone, and the scrapers may have been used in the preparation of new foreshafts.

Material selection for the Folsom points on the mesa was rather varied, as shown by the material types which were identified: one of tan/gray chert, one of waxy tan/gray petrified wood with red and brown inclusions, one of Red Hill obsidian, three of waxy white chert, one of pink/gray chert, one of light gray chert, one of Grants Ridge obsidian, and one of mottled cream/white chert.

MIDLAND

Three possible Midland projectile points were encountered within the Rincon Hondo area (Figure 29). These points are generally considered to be associated with the Folsom complex. The overall shape of the point is like the Folsom, but it is much thinner and somewhat more narrow. They also lack fluting, and the type was once called "unfluted Folsom."

Interestingly, a complete Midland was recovered on the same site as a Folsom midsection. The other two probable Midlands were found on the same multicomponent site which contained the Clovis point and numerous later materials. Both fragments had been heavily reworked and may have been curated and redeposited items.

Material types for these points were one of tan/gray felsite (a complete point), one of mottled purple chert, and one of red jasper. The felsite appears to be similar to that found near Sapello, New Mexico. This material is common on late PaleoIndian sites in northeastern New Mexico,

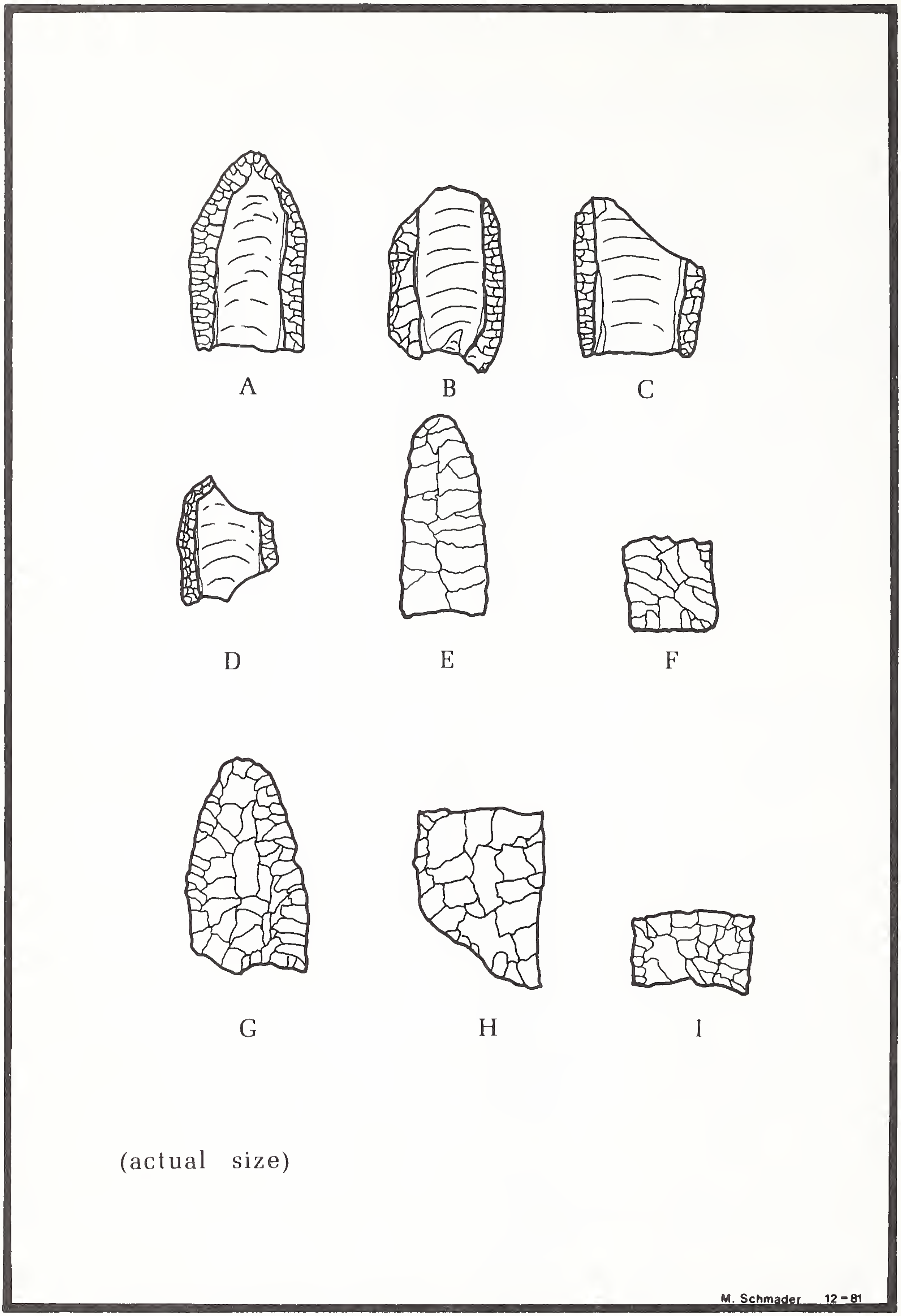

Figure 29. PaleoIndian Projectile Points from Cebolleta Mesa.

especially on Cody complex sites.

BELEN

This type is an unfluted lanceolate projectile point with a concave thinned base (Figure 29). There is still no definite evidence for its temporal placement. Judge (1973) sees it on morphological grounds as belonging between Folsom/Midland and the Cody complex. However, it has also been suggested that it belongs within the Cody Complex (Berman 1979:14).

Two definite Belen and three possible Belen points were located on three sites and as an isolated artifact. Four were found in and around the rincon, while the remaining point was located just north of a small playa on the western side of the mesa. Two of these were recorded with Clovis, Midland, and Cody materials. Material of manufacture consisted of two mottled maroon chert, one Jemez obsidian, one waxy tan chert, and one Polvadera obsidian.

EDEN (CODY COMPLEX)

Nine Eden projectile points were recorded in the survey sample blocks, and six of these were in the Rincon Hondo area (Figure 29). The other three were found on top of the mesa on a ridge system/overview located to the west of a series of small playas.

The Eden point type is characterized by a long narrow lanceolote blade which is usually collaterally flaked. Bases are slightly stemmed and sometimes indented the heavy grinding at the base and along the stem margins. No other Cody complex materials, such as Scottsbluff points or Cody knives, were observed in the survey area. The Edens were found on six sites and two were isolated artifacts. Additionally, an Eden base was recorded on the northeastern edge of a playa outside of the sample blocks.

Lithic materials were two tan felsite, one mottled red chert, two Grants Ridge obsidian, two Jemez obsidian, one Polvadera obsidian, and one reddish brown/gray chert.

The Cody complex has been dated between 7000 and 6000 B.C., and is considered the last stage of PaleoIndian occupations in the area (Irwin-Williams and Haynes 1970:64).

PALEOINDIAN UNKNOWN

Three unidentifiable projectile point fragments were recovered which were assigned to the PaleoIndian period because of morphology of production and material types. These points were found on two isolated occurrences and one was an isolated artifact. There were also a Belen point and several possible PaleoIndian waste materials were found on a site in the same quad.

All were midsections; two were manufactured from Washington Pass chert and the other was made from a clear chalcedony. One of the fragments of Washington Pass chert may well be part of an Eden point. The other two are probably either Belen or Midland projectile points.

CONCLUSION

Previously, the evidence for PaleoIndian occupations in the Cebolleta Mesa region has not been extensively documented. Dittert (1959:365-366), for example, only recorded 12 probable PaleoIndian projectile points. One was a Clovis and three others were Folsom points. The remaining eight were placed within the rather hazy Portales complex of the late PaleoIndian period. None were located on what would be considered PaleoIndian sites.

No stratified PaleoIndian sites have been found in the Acoma Cultural Province. All artifacts have come from either scattered surface finds or excavations of later Pueblo sites, or they are in the possession of modern Acomas. These latter points are valued for use in curing or as hunting fetishes. They are probably collected during sheepherding and hunting activities of individual Acomas (Ibid:516-518).

In general, knowledge of PaleoIndian utilization of high altitudes is rather limited within the Southwest. A single unfluted Clovis point was recovered from the Rio Valdez Divide in the Sangre de Cristos at an elevation of 11,500-12,000 feet (3505-3657 meters). Wendorf and Miller (1959:40;49) suggest that this point was deposited by a later group of people, as the elevation of the site is above a late Wisconsin moraine. Sites containing Cody knives, and Agate Basin, Allen, Eden, and Meserve projectile points have been recorded at elevations of 11,000

feet (3355 meters) to 11,500 feet (2507 meters) in the Colorado Front Range. No Folsom materials were found but one isolated Clovis projectile point was recorded as an isolated artifact (Husted 1965:495-496). These sites are generally located in the mountain passes, unlike the Cebolleta materials. In addition, a possible Folsom preform fragment was located on the Mescalero Apache Reservation timber sale survey at an elevation of 7440 feet (2267 meters) (Broster 1980:2). This preform was very battered and was located on a site that clearly dated to the Late Archaic. It probably represents a curated and reused item.

The appearance of so many PaleoIndian artifacts at high elevations on Cebolleta Mesa is a unique situation compared with other areas. Before the survey, it was felt that sites of PaleoIndian orgin might exist on the mesa, but that they would probably be unidentifiable. Since it has been proposed that PaleoIndian projectile points are specialized items made for the hunting of large Pleistocene herd animals, it was believed that they would only be found at lower elevations.

One possible explanation for the occurrence of these points is that they were brought to the area by later Archaic populations and reused. To test this possibility, all tools and points found in direct association with later materials or showing distinct reuse or modification from their original form were considered as curated items, and were discounted. The one Clovis, three Folsoms, two Midlands, four Belens, and five Edens were therefore dropped from the study.

However, this left 14 projectile points which could not be accounted for by this possibility. It is probable that these points were deposited by PaleoIndian hunters and gatherers in the exact area in which they were archeologically recorded. These include six Folsoms, one Midland, two Belens, and three Edens, which were located both within Rincon Hondo and in association with the playas on top of the mesa.

The location of PaleoIndian materials at the margins of palyas suggests the same site pattern and subsistence activities that occur in the Middle Rio Grande Valley. One site in particular was found to the northeast of one of the playas and contained numerous preform reduction flakes, secondary retouch flakes, and one fragment of a projectile point, probably either a Midland or Belen.

It is apparent that both the lakes and the rincon were utilized by PaleoIndian groups quite extensively and over a long time range. The PaleoIndian artifacts recorded around the lakes suggest probable post-hunt activities and the use of overlooks to observe the movement of game. These items are located to the north and northeast of playas, and are possibly related to the placement of sites downwind from potential game resources.

The use of the rincon may be divided into several types of primary utilization. The location of several of the Folsom points along the mesa's talus slope suggests that animals were driven from the playas over the edge of the mesa rim. The rincon may have served as a trap where animals were driven up the drainage from the plains and entrapped within the rincon.

OUT OF PHASE:
LATE PITHOUSE OCCUPATIONS IN THE HIGHLANDS OF NEW MEXICO

David E. Stuart and Robin Y. Farwell

INTRODUCTION

Southwestern archeology has depended heavily on its great classificatory frameworks. In New Mexico these are the Pecos Classification and the Mogollon Sequence. The first is ordinarily applied by field archeologists working north of Socorro, New Mexico, and west of the state's central highland pine. The Pecos sequence presumes that the archeological populations being described are Anasazi.

The Mogollon sequences (Wheat 1955) suffer somewhat more regionalism as applied (Alpine Branch, San Simon Branch, Mimbres Branch, Jornada Branch and Southeastern Extension of the Jornada Mogollon). Together these encompass nearly the entire southern tier of New Mexico. In this chapter we are concerned only with the areas south of Socorro, New Mexico, and west of the eastern foothills of the Capitan-Sierra Blanca-Sacramento highlands. This imposes a rough geographic symmetry with the usual extent of the Pecos Classification's application. We, therefore, exclude the San Simon and the Southeastern Extension of the Jornada from our direct consideration (Figure 30).

Most archeologists would agree that these classificatory schemes have offered us a perplexing, sometimes painful, combination of interpretive benefit and burden. In this chapter, we present evidence for late (post A.D. 1000) pithouse occupations where, on balance, interpretation appears weighted toward burden.

Our objectives are to bring a general picture of these pithouse settlements into the literature; to place them, temporarily, into the standard classificatory schemes; and to suggest an explanation for their distinctive site setting and subsistence characteristics.

TEMPORAL/CLASSIFICATION BACKGROUND

In terms of the Pecos classification, pithouse architecture is associated with the later Basketmaker II (primarily A.D./B.C. to A.D. 400), the Basketmaker III period (A.D. 400-700), and, to a lesser extent, the Pueblo I period (A.D. 700-900). In the eastern Anasazi area, most consider the "heyday" of pithouse settlements as falling in the Basketmaker III period. Sites such as Shabik'eshchee Village (Roberts 1929) and Tohatchi Village (Peckham 1969) exemplify a period where moderate to large villages (often 10 to 20 pithouses) are found. These, typically, have large, deep pithouses and only modest surface structures.

Archeologists in northwestern New Mexico have been flexible in local areas, often dating late pithouse villages to the A.D. 800s. Depending on the general size of these and characteristics of the ceramic assemblages, they may either be termed "a late Basketmaker III village" or "Pueblo I village." There is general agreement that the proportion of surface to subsurface architecture continues to vary substantially from site to site during the Pueblo I period.

Since the Pueblo I period is considered "transitional," this architectural variability has generally not created much anguish from the classificatory perspective. Nonetheless, the late, deep pithouse sites of the Navajo Reservoir district have caused many archeologists to balk at application of the Pecos Classification and the Rosa-Piedra phase occupations are sometimes discussed in an enigmatic fashion. Though the Rosa-Piedra sequence is not well-dated throughout its geographic range, it is rather clear that this episode of pithouse construction does not fade from the Eastern Anasazi heartland until roughly A.D. 900 or 950. A problem is created because these dates intrude into the early Pueblo II period and cannot be absorbed by flexible application of the late Basketmaker III/Pueblo I Classifications.

Notably, these lingering pithouse settlements become shallower and more rectangular at the terminus of the Piedra phase. Thereafter, an occupational hiatus envelopes the areas where they flourished in colder, upland districts.

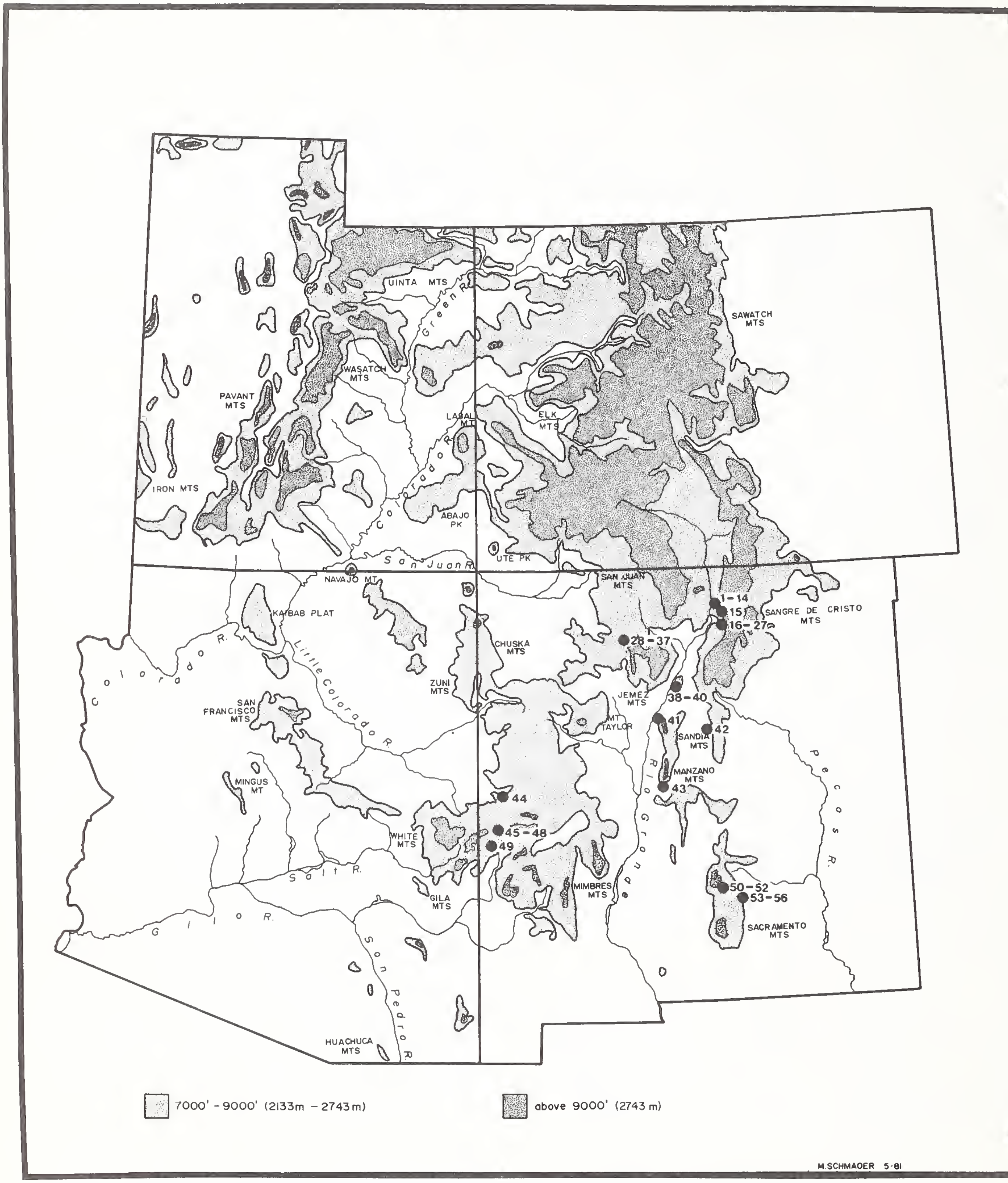

Figure 30. Locations of High-Altitude Sites in New Mexico.

In the Mogollon districts of southern New Mexico, the terminus of pithouse construction is not simultaneous from locale to locale, either. In these regions, the "heyday" of the deep, roughly circular pithouse constructions is termed the San Francisco Phase (roughly A.D. 650-850; see Stuart and Gauthier 1981). The succeeding Three Circle phase is a period of robust village development, averaging over 20 pithouses per village. In the Mimbres district, Three Circle phase construction can be rather narrowly dated as an episode which spanned the A.D. 850-900 period (see LeBlanc and Whalen 1979; Stuart and Gauthier 1981:193).

The Three Circle pithouses are generally quite shallow, slab or cobble based, and rectangular, like Piedra phase pithouses to the north. In the Reserve area, Wheat (1955) suggests that the Three Circle phase did not begin until just after A.D. 927. This is based on tree-ring dates from two pithouses, one of which is in Mogollon Village. Not surprisingly, Breternitz (1966) contests Wheat's phase designation, for his primary interest at the time focused on ceramic assemblages rather than architecture. In short, the Mogollon Village pithouse contained a fully developed Three Circle phase ceramic assemblage, according to Breternitz. In Wheat's judgment the depth of the pithouse and other architectural features required a late San Francisco Phase designation.

Now this is a nice little story, for it illustrates three important points:

1) Classificatory schemes which assume temporal symmetry in architectural and ceramic change often present real difficulties of application in practice. This is particularly so where regional sequences have been built on a tendency to shift back and forth between major diagnostic features from one phase to the next. This difficulty is compounded by the recent emphasis on survey, rather than excavation, in contract archeology. Pithouse depth is, of course, not observable during survey.

2) Major phase changes in pithouse villages are not simultaneous throughout even the Mogollon heartland.

3) Specifically, the Three Circle phase, and shallower rectangular pithouses, begin later in the Pine Lawn-Reserve district than in the Mimbres district. Let us pursue this last point.

In the Mimbres district, most excavated Three Circle phase sites lie between 1524 and 1828 meters in elevation, while in the Pine Lawn-Reserve districts, these sites range from 1859 to 2134 meters in elevation. Here, as in northern New Mexico, the deep pithouses lingered on briefly in a colder, more upland setting. In the Mogollon area, complete transformation to above ground masonry architecture also came sometime after A.D. 950. It is disputed precisely when this occurred for, like the Navajo Reservoir district, only a few sites are dated. In the Mimbres district, per se, Classic period roomblock construction is definitely dated to A.D. 1050, and thereafter. Most authorities agree, however, that the older pithouse style of construction ended about A.D. 1000. The absence of tree-ring dates between the final episode of Three Circle phase construction and the earliest Classic Mimbres construction suggests and interlude of some sort in the Mimbres district. The implications of this interlude are not quite the subject of this chapter and are discussed more fully elsewhere (Stuart and Gauthier 1981).

In short, there are several parallel patterns in the archeology of the eastern Anasazi and western Mogollon areas. In each region the transition from deep to shallow pithouses and, finally, to surface architecture is not simultaneous. Deep pithouses linger on, "out of phase" in certain colder, more upland portions of both regions. In both regions, the transition to shallow pithouses in upland areas can be generally dated to between A.D. 900 and 950. In the lower, drier basin areas of each district the shift to shallow, rectangular pithouses, followed by above ground architecture, is a bit earlier. In both regions there is evidence for either a substantial shift in settlement (population moves out of the Navajo Reservoir district during the Arboles phase) or some unidentified dislocation in the late pithouse districts before construction of above ground architecture.

The bulk of excavated Mogollon settlements were still in the Three Circle phase (shallow, rectangular pithouses) at precisely the point of alleged transition (A.D. 850-950) from Pueblo I to early Pueblo II architecture (small surface unit

pueblos) in the Anasazi region. This is one reason why Mogollon development is generally argued to be distinct from Anasazi. A great deal of attention in the formal literature has been lavished on temporal/developmental differences between the two regions. This has tended to obscure a surprising undercurrent of similarity.

Moreover, the traditional focus of eastern Anasazi archeology (Mesa Verde is an exception) has been on the central and southern San Juan Basin rather than its more heavily forested upland periphery. In the Mogollon heartland, precisely the opposite geographic focus has unfolded. There, nearly all of the sites ever excavated are in the upland mass in which the Gila Wilderness is centered. Those few which are not in the higher elevations are mostly larger, Classic Mimbres sites in the upper valleys of the major streams draining out of the mountainous core.

How few sites in the more desertic lowlands of the Deming Plain have been excavated? Most of these are recorded merely as sherd scatters, but perhaps more intensive investigation and soil testing would offer some evidence of adobe surface constructions, as the structural features have long ago eroded into the sandy desertic soils. It is quite possible that focus on excavating in these differing settings has contributed more than we think to contrasts between the two regions.

More to the point, even stretching the Pecos Classification to the limits in artful application of the "Pueblo I/Transitional" site model, pithouse occupations after A.D. 900 are an enigma in the literature. The actual evidence suggests that in the Anasazi area even these few "problem" sites became extraordinarily rare for a century and a half after A.D. 950, and the expansive Pueblo II period literature is hardly burdened with further troublesome episodes like the late pithouses of the Navajo Reservoir district. Even later, post Pueblo II pithouse villages are known but generally ignored in the literature. Later pit structures are often designated as kivas, whether or not architectural and artifactual materials warrant it. This avoids further classificatory problems.

In the Mogollon region documented pithouse construction after A.D. 950-1000 has been discussed but continues to raise questions. There, the Reserve-Pine Lawn region has suffered its "Rosa-Piedra enigma" in the form of pithouses constructed in the late A.D. 1000s. Even here, where many pithouse villages post-dated those in the Anasazi area, the cultural sequence could not accommodate this phenomenon and the troublesome Apache Creek phase was born (Peckham, Wendorf, and Ferdon 1956; see also Berman 1979). Let us take this post A.D. 1000 pithouse phenomenon as our point of departure for the remainder of our discussion.

PITHOUSE OCCUPATIONS "OUT OF PHASE"

The Data

Southwestern archeologists, of course, know that pithouse occupations occur after A.D. 1000 in several districts of New Mexico. The Apache Creek phase of southern New Mexico has been discussed in the literature. In the Anasazi region, the allegedly "backward" Gallina (or Largo-Gallina) phase occupations of the A.D. 1100s and 1200s has long attracted attention (Hibben 1938, 1944, 1948), though far more emphasis has been placed on the masonry towers and rare cliff houses than on the actual pithouses, which are vastly more numerous (Seaman 1976).

Where else do similarly late pithouse occupations occur? How many have been excavated? What is the temporal span of these later pithouse constructions? How do these relate to the mainstream of Anasazi/Mogollon development?

These questions have never been fully treated as a theme in the literature. In order to address these we have drawn together as much of the excavation data as possible. Our primary domain is the State of New Mexico, rather than the Southwest as a whole. A surprising quantity of this material exists but lies in unpublished files of one or another institution. These general excavation data are summarized in Table 7. Many data are only inconsistently available. For instance, pithouse depth from the original occupation surface is infrequently noted and in several cases pithouse depth is not noted at all. These lacunae took us rather by surprise and created analytical problems to which we have responded with only partial solutions. Perhaps others will discover more

effective means to overcome these difficulties and it may be that future excavations will more consistently include these pertinent details.

Many southwestern archeologists will be surprised to discover that about 60 pithouse sites post-dating A.D. 1000 have been excavated in New Mexico; the majority since 1950. In the sample presented here, 147 pithouses occur at the 50 odd sites which have been summarized. Field notes indicate that 103 of these pithouses have been excavated. Survey records (not summarized in detail for this study) include, literally, several hundred additional sites. Anecdotal reports (Seaman 1976; Dutton 1964; Marshall 1981; Farwell and Oakes n.d.; Beckett, personal communication; and Broster, personal communication) indicate that additional hundreds of post A.D. 1000 sites are not yet formally recorded in several important archeological districts. In short, we are certainly talking about 500 or more "atypically" late pithouse sites in New Mexico and perhaps as many as 1000. By way of comparison, only about 200 Basketmaker II sites have been recorded in the entire State of New Mexico (Stuart and Gauthier 1981) and just about 1000 Basketmaker III sites are known from the entire eastern Anasazi area.

Geographical Content

Published data indicate that post A.D. 1000 pithouse settlements are numerous in the Taos district of northern New Mexico; these sites are attributed, generally, to the Valdez phase (A.D. 1100-1300). In the Gallina district, hundreds of anecdotally reported pithouse sites are attributed to the Gallina phase (about A.D. 1100-1275), and well over a hundred are formally recorded.

Late pithouses (also called "house pits" or "pit rooms") have been excavated in the Cochiti Reservoir area (Snow 1976; Lange 1968; and Biella and Chapman 1977-79), in the Galisteo Basin (Dutton 1964) and in the Albuquerque district (Wiseman 1980). The Center for Anthropological Studies reports survey of numerous small pithouse villages

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Key for Table 7

*	depth below prehistoric ground surface; all other depths given are from ground surface at the time of excavation
#	floor contact assemblage. Others are general pithouse fill artifacts unless otherwise noted
A	archeomagnetic date
TR	tree-ring date
blanks	data was either not recorded or not separated by pithouse and surface rooms
B/w	Black-on-white
proj. pts.	Projectile points
B/g	Black-on-gray
G/r	Glaze-on-red
G/y	Glaze-on-yellow
B/r	Black-on-red
BF	Boldface
R/t	Red-on-terra cotta

INDEX CODE	SITE	REFERENCE	LOCATION	ELEVATION	EXPOSURE	NUMBER OF PITHOUSES	FEATURE NO.	DEPTH IN METERS	DATES	CERAMICS	LITHICS	GROUNDSTONE	CORN	BURIALS	COMMENTS
1	Site 83	Blumen-schein 1956	Taos	2253m 7400 ft.	SW	1?		1.8	Valdez Phase	Ceramics from these sites include a min-eral painted B/w probably dating 1000-1150. Taos B/w, early Taos, incised and large, numbers of culinary wares				2 in fill	
2	Site 95			2225m 7300 ft.	SW	1?		2.4							
3	No Number			2225m 7300 ft.	SW	1?		2.4							room had two floors-trenched only
4	Site 103	Blumen-schein 1958	Taos	2225m 7300 ft.	SW	1?		2.1	Valdez Phase	From all 3 sites: Plain Grey 68.3 Painted sherds scarce-all PI-PII Chacoan types.			Similar to that grown at Taos to-day-like Basket-maker-early Pueblo.	9 in fill; 4 w/ skulls miss-ing, 1 iso-lated jaw frag-ment.	No adja-cent sur-face struc-ures found with any of the 3 sites.

Table 7. Survey of Late Pithouse Sites in New Mexico

5	Site 102					1?		2.5						1 scat-tered in fill	room was trenched only
6	Site 104					1?		2.4						1 in fill	possible storage pit out-side pit-house-trenched only
7	LA 9200	Loose 1974	Arroyo Hondo	2515m 8200 ft.	W	1		2.4	Valdez Phase	Taos B/w 2.4 Taos Grey all 94.3 Red Mesa B/w 1.3 Unident B/w 2.0				1 on floor-SW Pla-teau type	3 sur-face rooms
8	LA 9201			2195m 7200 ft.	W	5 (3 ex-clu-ded	1	2.6		Taos Grey 91.9 Taos B/w 2.8 Red Mesa B/w 0.8 Unident B/w 6.4					3 sur-face rooms-2 other pit-houses excavat-ed by Blumen-schein 1958.
							2	2.4		Taos Grey 99.0 Unident B/w 1.0					
							3	2.4		Taos Grey 98.3 Unident B/w 1.9		mealing bin			

9	LA 9203			2408m 7900 ft.	W	1		2.4		Taos Grey 94.1 B/w 6.9					1 surface room
10	LA 9204			2408m 7900 ft.	W	1		2.3		Taos Grey 100.0	3 proj. pts.				4 surface rooms/say pit-house was re-modeled into a kiva
11	LA 9205			2347m 7700 ft.					A 1120±25	Taos Grey 97.9 Taos B/w 2.0					SURFACE STRUCTURE included because only ab-solute date in area
12	LA 9206			2358m 7720 ft.	W	1		1.8	Valdez Phase	Taos Grey 97.6 Taos B/w 2.4					4 surface rooms
13	LA 9207			2353m 7720 ft.	W	1		2.6		Taos Grey 98.2 Taos B/w 2.6 Red Mesa B/w 0.1	13 proj. pts. 3 scrap-ers 3 knives 1 drill	2 manos			
14	LA 9208			2347m 7700 ft.	W	1		2.9							2 surface rooms
15	Site 268	Wolfman et al 1965	Arroyo Seco	2286m 7500 ft.		1		2.4	Valdez Phase	Taos B/w 15.0 Utility 85.0	3 proj. pts. 1 knife 1 scrap-er	10 manos 9 metates			

16	TA 32	Leubben 1968	Rio Grande de Rancho	2255m 7400 ft.	N	1		2.4	Valdez Phase	Taos Grey 64.9 Taos Incised 13.8 Taos B/w 19.8 Other 0.2		like Papago and late BM		1 surface room
17	TA 34	Cordell 1979	Taos	2255m 7400 ft.					A 1190+20					Cordell cites a letter from Eighmy (1968) to Wetherington with this date for pithouse TA 34-no further information avialable.
18	TA 1	Green 1963	Rio Grande de Rancho	2271m 7450 ft.	SW	2	A B	1.5 1.8	Valdez Phase		All pithouse site artifacts are discussed together. Comparison with surface rooms (TA 47) indicates more dependence on agriculture at TA 47 and more on hunting in pithouses.		in fill	Pot Creek pueblo rooms overlying so rooms may have been deeper.

19	TA 10					1		2.6		Taos B/w 27.5 Unident B/w 42.5 Plain 30.0				3: 1 with crushed skull	
20	TA 18			2225m 7300 ft.	W	4	A	2.5		Taos B/w 16.6 Unident B/w 12.5 Taos Incised 4.1 Plain 66.6				1 in fill	
21							B	2.5		Taos B/w 61.1 Taos Incised 5.5 Plain 33.3				3: 1 with crushed skull, 1 with broken bones	
22							C	2.7		Taos B/w 13.5 Unident B/w 15.8 Taos Incised 3.5 Plain 68.4					
23							D	2.6		Taos B/w 88.8 Unident B/w 11.1				4: 2 with crushed bones, 2 with broken necks	2 floors
24	TA 20			2256m 7400 ft.	SW	2	A	1.7		Taos B/w 21.7 Unident B/w 17.4					

										Taos Incised 8.1 Plain and Other 53.9					
25							B	2.3		Taos B/w 20.0 Unident B/w 17.2 Taos Incised 6.5 Plain and Other 56.3				1 in vent	
26	TA 112			2164m 7100 ft.	SW	1		1.9							
27	TA 47								TR 1077+vv 1147r	Taos B/w 22.5 Taos Incised 8.0 Plain and Other 69.6					SURFACE STRUCTURE included as only Valdez Phase dates in area
28	AR-03-01-02-02	Dick 1976	Gallina (Huer-fano Mesa	2170m 7120 ft.	W	1		2.2	Gallina Phase					Evidence of dis-member-ment prior to burials in cut-ing stria-tions on some bones & no	Pithouses occur w/ surface build-ings of masonry or jacal 30% of the time. No arti-fact analysis avail-able as

														burial 100% intact; violence evident in 60% of adults.	of this writing.
29	02-03					1		1.8	TR 1230 (tentative)						
30	02-30A					1		2.5	Gallina Phase						
31	02-32					1		1.6							
32	02-63					1		2.4							
33	LA 11843	Seaman 1976	Gallina	2286m 7500 ft.	W	1		2.1	TR 941vv-1101vv	Grayware 8.3 Utility ware 91.6	11 proj. pts. 4 preforms 7 bifacial tools 2 scrapers	22 metates 36 manos		8 in trash	Floral remains support Seaman's conclusion that site emphasized the processing and storage of food/assoc. jacal structures and 16 exterior hearths.

34	LA 11850	Fiero n.d.	Gallina	2134m 7000 ft.	W	2	No.	2.0	TR 1183r 1231r	Gallina B/g 57.0 Gallina Utility 43.0		81 manos 8 metates	12 rowed most common		20+ surface rooms and 2 towers associated/whole site abandoned by A.D. 1245
							So.	2.0	TR 1235rB	Gallina B/g 24.0 Gallina Utility 76.0		24 manos 4 metates			
35	Bg 50 (Archuleta ruin)	Green 1956	La Jara	2286m 7500 ft.	W	1		2.4	TR 1025vv- 1245vv	Gallina Utility 74.6 Gallina B/w 6.8 Corrugated 18.6	8 flakes 3 scrapers	11 manos 3 metates			possible assoc. surface structure
36	LA 3570	Peckham & Reed 1963	Ranchos de Taos	2237m 7340 ft.	W	1	(est)	2.4	Valdez Phase	Taos Grayware 81.0 Kwahe'e B/w 15.0 Whiteware 3.8	2 scrapers	none			Pithouse in roadbed-less than .30m of wall remain
37	LA 3643			2085m 6840 ft.	W	1		2.2		Taos Grayware 86.2 Kwahe'e B/w 16.9 Santa Fe B/w 1.1	1 proj. pt. 6 knives 8 scrapers	3 metates 5 manos		in floor pit/SW Plateau type	
38	LA 70	Snow 1976	Cochiti	1621m 5320 ft.	E	6	140	2.0	Glaze Period	Agua Fria G/r			2 types: 1 typical of Cochiti		Pueblo room overlying
							157	1.9		Agua Fria G/r					

							223	2.1	TR 1327++vv 1350vv	Agua Fria G/r Wiyo B/g, Abiquiqu B/g, Cieneguilla G/y, Largo G/y, Galisteo B/w	1 scraper, 1 utility flake		area and widely distributed prehistorically. 8-14 rows. 2nd type 16 rows & larger cob.		
							226		Glaze Period	Agua Fria G/r, Wiyo B/w, Abiquiqu B/g, Cieneguilla G/y					Site had 200+ surface rooms 6 pit room and 2 kiva
							258	1.3		none on floor					
							269	1.9		Agua Fria G/r, Cieneguilla G/y					
39	LA 6455	Lange 1968	Cochiti	1615m 5300 ft.	E	10-12 (7 exc)	4	1.2	Glaze Period	Ceramics (east sector) Glazes: Agua Fria G/r 95.9 San Clemente G/p 3.6 Cieneguilla G/y .4 B/W: Biscuit A 89.4				31 in fill of pit rooms	Pit rooms arranged in L-shaped, contiguous alignment around central plaza. Assoc.
							6		TR 1342vv						
							8	1.1	TR 1318vv						

							9 10	1.2		Galisteo B/w 5.2 Wiyo B/w 5.2					surface storage rooms on same axis/ depths not re-corded-those listed were ob-tained from il-lustra-tions-average depth cited as over 1 m with deepest at 1.7 m.
							11 12		TR 1318vv						
40	LA 12522	Biella & Chap-man 1977-1979; Vol. 2	Cochiti	1676m 5500 ft.	E	2	1	1.9	A 1190	Kwahe'e B/w 24.0 Santa Fe B/w 24.0 Corrugated 68.0 Plain 2.0		1 mano	present		surface rooms assoc.
							6	1.6	Glaze Period	Santa Fe B/w 26.0 Cieneguilla G/y 8.7 Espinoza G/p 4.3		none			pueblo room overlying

41	LA 4955	Site Survey Records	Cochiti	1548m 5080 ft.	E	1		1.5		Corrugated 4.3 Plain 56.5 Santa Fe B/w Wiyo B/w St. Johns Poly Utility					
42	LA 3333	Dutton 1964	Galisteo	1964m 6445 ft.	E	9	ave.	.6	TR 1225B (from kiva)						surface rooms and two kivas assoc.
43	LA 10794	Wiseman 1980	Tijeras	1780m 5840 ft.	W	7	161	.4	TR 1304 vv A 1183+ 32			1 mano	that which is common to pre-historic sites in the Rio Grande-10, 12, 14 row	none	Pithouse 132 over-lying Pueblo room over-lying
							154	.9	A 1375+ 45	Santa Fe/ Wiyo 27.3 St. John's B/r 9.0 local utility 63.6					
							29	.7	Coalition Period		1 proj. pt.	1 mano			
							105	.7		Santa Fe/ Wiyo 20.0 Local utility 72.5 Socorro B/w 2.5 Los Lunas Smudged 2.5 Unident 2.5	2 proj. pts.	1 mano			
							132	.6			1 proj. pt.	1 mano mealing bin			

							148	.6		Local Utility 50.0 Kwahe'e B/w 50.0	1 proj. pt.	1 mano			
							155	1.0				2 manos			Pueblo room over-lying
44	Site 616	McGimsey 1980	Mariana Mesa	2225m 7300 ft.	W	? (3 exc)	D5	1.5	1100-1300			meal-ing bin	8, 10, 12 row		Pueblo room over-lying
							E1	1.1			1 proj. pt.			one on floor slight evi-dence of bat-tering	Site is an enclosed plaza with 500+ con-tiguous surface rooms with contem-poraneous pithouses and a kiva.
							E2	1.5		Tularosa B/w		7 manos 1 me-tate mealing bin			
45	Jewett Gap	Bullard 1950	Apache Creek	2469m 8100 ft.	W	14 (5 exc)	A	1.0	Tularosa Phase	Not analyzed but notes St. John's Poly and Tularosa B/w on floor of one pithouse	"Projec-tile points were not frequent"	7 me-tates			25 room pueblo assoc.
							B	1.0				several metates			
							C	1.5	TR 1127B 1159B			1 me-tate 4 manos			"was pro-bably con-structed in A.D. 1127 with repair in 1159"

							D	1.5	Tularosa Phase						
							E	1.8				3 metates 4 manos 2 mealing bins			
46	LA 3260	Schroeder and Wendorf 1954	Apache Creek	1966m 6450 ft.	W	4 (2 exc)	1	1.3	Early Tularosa	Reserve B/w 1.5 Tularosa B/w 3.0 Alma Plain 16.6 Tularosa fillet 1.5 Corrugated 45.4 San Francisco Red 1.5 Reserve Smudged 28.8 Unident 1.5	1 proj. pt.	(metates were found only in surface rooms)		tibia in ventilator	Site consists of 2 surface rooms and 4 or 5 pithouses
							2	1.3		Reserve B/w .3 Tularosa B/w .3 Red Mesa B/w .3 Alma Plain 7.6 Tularosa fillet 1.2 Corrugated 67.4 San Francisco Red .3				in fill	

47	LA 2949	Peckham et al 1956	Apache Creek	1963m 5440 ft.		27 (7 exc)	1	2.1	Apache Creek	Reserve Smudged 20.4 Unident .3 Alma Plain 22.0 San Francisco .9 Tularosa fillet 6.5 Smudged 22.7 Corrguated 37.1 Mimbres BF 2.6 Reserve B/w .4 Tularosa B/w 4.8 Red Mesa B/w .9 Wingate B/r .4 Whiteware 1.3	1 proj. pt.	? metates ? manos	described as stunted		Site consists of 7 roomblocks & 27 pithouses wit a possible great kiva type site for the Apache Creek Phase
							2	2.2		Alma Plain 20.5 San Francisco Red 1.8 Tularosa fillet 4.4 Smudged 19.4 Corrugated 43.8 Mimbres BF .8		? metates ? manos 2 mealing bins		6 on floor or in pits-no evidence of violence	

										Reserve B/w 2.9 Tularosa B/w 4.7 Red Mesa B/w .8 Wingate B/r 1.2 Whiteware 2.6					
							3	2.1		Alma Plain 2.5 Smudged 13.6 Tularosa fillet 6.2 Corrugated 64.2 Reserve B/w 1.2 Tularosa B/w 7.4 Red Mesa B/w 1.2 Whiteware 3.7		? manos mealing bin		in floor pit	
							4	2.1		Alma Plain 13.8 San Francisco Red .2 Smudged 5.3 Tularosa fillet 2.3	? scrap- ers	? metates ? manos 2 mealing bins		5 in floor pits	

										Corrugated 73.5 Reserve B/w .5 Tularosa B/w 2.5 Wingate B/r 1.3 Whiteware .5					
							5	1.2		Alma Plain 37.2 San Francisco Red 3.1 Smudged 11.7 Corrugated 32.1 Mimbres BF .5 Reserve B/w .5 Tularosa B/w 10.2 Wingate B/r 3.7 Whiteware 1.0	? scrapers 1 knife				
							6	2.6		Alma Plain 7.4 Smudged 23.4 Tularosa fillet 13.6 Corrugated 49.4 Tularosa B/w 3.7 Red Mesa B/w 1.2 Wingate B/r 1.2				2 in floor pits	

							7	2.1		Alma Plain 17.6 Tularosa fillet 14.7 Smudged 23.5 Corrugated 32.3 Reserve B/w 2.9 Tularosa B/w 8.8		? metates ? manos 2 mealing bins		3 in floor pits	
48	LA 4986	Kayser et al 1972	Whiskey Creek	2088m 6850 ft.	W	2	8 9	2.0 1.2	Apache Creek Phase	Wingate B/r Red Mesa B/w Reserve Plain Corr Tularosa fillet rim San Francisco Red		3 mealing bins			Kayser calls these "pithouse-kivas"
49	LA 8682	Martin et al 1957	Reserve	1810m 5940 ft.		1		1.5	Tularósa Phase	Alma Plain 15.9 San Francisco Red 2.6 Reserve Smudged 18.2 Reserve B/w 1.5 St. John's Poly .3 Tularosa B/w 9.2 Red-on-brown .3 Kiatuthlanna B/w .8 Wingate B/r .3 B/w 4.1 Corrugated 46.8	1 proj. pt. 4 knives 6 scrapers	1 metate 8 manos			called a "pithouse-kiva"

50	LA 16297	Farwell & Oakes n.d.	Scra-mentos	2100m 5890 ft.	W	1		.4	Glencoe Phase	Chupadero B/w 14.0 Three Rivers R/t 5.0 El Paso Poly .6 El Paso other 16.0 Jornada 64.6 San Andres R/t .5	7 proj. pts. 2 scrap-ers 1 blade 1 knife	3 meta-tes 10 manos	Zea mays-10 row with fairly large kern-els	3 out-side of room	
51	LA 2315			2097m 6880 ft.	E	8	A	1.2	A 1200±16	For all pit-houses: Chupadero B/w 9.0 Three Rivers 15.0 El Paso-all 28.0 Jornada-all 44.6 San Andres R/t 2.0 Local Corrugat-ed .3 Mimbres white-ware .4 Intrusives 2.1	All: 73 proj. pts. 19 scra-pers 14 drills 10 blades 9 knives	All: 50 manos 37 meta-tes	Zea mays-12 rowed	2 in floor pits	shallower pithouses were all at east end of site, deeper ones at west end.
							M	1.2	Glencoe Phase					2 in fill	
							P	1.6						1 in fill	
							S	.6	A 1100 or 1360±24						
							T	.6	Glencoe Phase						
							AA	.8						1 in fill	
							BB	1.2							
							CC	1.5						2 in fill	

52	LA 3334	Site Survey Records	Sacra-mentos	2095m 6875 ft.	E	4	1	.6				1 mano	noted		
							5			Lincoln B/r Gila Polychrome					
							6								
							7			El Paso Poly-chrome Gila Polychrome San Andres R/t Chupadero B/w					
53	Bonnell	Kelley 1966	Sacra-mentos	1756m 5760 ft.	E	20	1	1.1	Glencoe Phase	Chupadero B/w Brownware			"small size cob-such corn might be expected from site of consi-derably earlier vintage"		
							3	.4			? proj. pts.	? manos			
							4	.6			? scrap-ers	1 meta-te			
							7	.2			1 knife	1 meta-te			
							8	.3			9 proj. pts.				
54	LA 5378	Broilo 1971	Sacra-mentos	1774m 5820 ft.	E	4			Three Rivers Phase	Chupadero B/w Brownware		1 metate		1 in floor pit	
55	LA 5380			1719m		1									
56	LA 2000	Jennings 1940	Penasco	1719m 5640 ft.	E	2	1	.3	1100-1350	El Paso Poly-chrome Brownware Mimbres Classic Three Rivers R/t Chupadero B/w St. John's Polychrome	2 proj. pts. 2 scrap-ers	4 me-tates	noted	3 ex-tra-mural, Pecos physical type	
							2	.3							

having Santa Fe Black-on-white ceramics (A.D. 1175-1300) from the west face of the Manzano Mountains near Albuquerque (H. Franklin, personal communication).

The Zuni highlands, which encompass the Zuni, El Morro, and Cebolleta Mesa archeological districts present an unclear picture, both formally and anecdotally. Zier (1975) reported a Pueblo III pithouse on the Zuni Reservation and Marshall (1981) recorded a late pithouse village there; the widely "scattered Early Pueblo III kiva depressions" reported by Hunter-Anderson (1978) strike us as worthy of closer scrutiny. In that region, however, most archeologists expect to see "kiva depressions" rather than "pithouse depressions." Since Robert's (1932) study of the Village of the Great Kivas, this is not surprising. Nonetheless, from surface survey alone, subterranean architectural features and religious artifactual assemblages can only be guessed at. Could there not be a few pithouses sprinkled amongst the "kivas?" As we shall soon see, the elevation and site settings are similar to those of other later pithouse occupations. The time frame (early Pueblo III) is "right" and the ceramic assemblages may be as well (St. John's Polychrome scarce or absent but Puerco Black-on-red sometimes present.) Further, just 64 kilometers to the south of the Yellowhouse survey area lies Site 616 on Mariana Mesa where McGimsey (1980) excavated Pueblo III period pithouses occurring in a larger masonry site.

Further to the south and east, late (A.D. 1100-1300, roughly) pithouse sites are anecdotally reported (Beckett, personal communication) from Chupadero Mesa in the Gran Quivira region. To the south and west dozens of Apache Creek phase sites are recorded and several excavated ones are presented here. In the Capitan-Sierra Blanca district Kelley (1966) reported late Capitan and Glencoe Phases pithouses (roughly A.D. 1100-1300+). In that region, similar sites have been surveyed, excavated, and reported by others (Jennings 1940; Broilo 1971; Wiseman 1979; Farwell and Oakes n.d.; LA 3334, Site Survey Records).

In areas adjacent to New Mexico post A.D. 1000 pithouse sites have been excavated in the Point of Pines region, Arizona (the Willow Creek Phase, see Wendorf 1950); the Shonto Plateau of Arizona (Anderson 1969) and in the Flagstaff district (see Martin and Plog 1973).

In short, late pithouse occupations occur in, or adjacent to, every major highland area of New Mexico. Our data are sketchy from the Zuni-Acoma area and we have, so far, no data from the higher elevations of the Chuskas. In the general area of the Cibola cultural province, the tendency to describe surface depressions as "great kivas" may be partly obscuring the issue.

Temporal Control

Most late pithouse occupations have been dated solely on the basis of ceramic cross-dates. The phase designations of sites in our sample and traditionally used dates are given in Table 8.

Late pithouses dated by absolute means are quite scarce in the literature. Those that are known from New Mexico are listed in Table 9.

There are 12 dated sites (15 dated pithouses) and these fall neatly into two groups. The first of these is bracketed in the extreme by the 941vv date at LA 11843 and the 1245vv date at Bg 50, both Gallina sites. The mean of the 14 dates (including multiple samples) is A.D. 1154 (S.D. 87.96 years). The range, taken the standard deviation, is from A.D. 1066 to 1242. This is quite in line with the generally accepted phase dates outlined in Table 8. Using only the more precise "r," "rb," and archeomagnetic dates from this series we arrive at a mean of A.D. 1184 (S.D. 44.4 years) and a span of A.D. 1139-1228. Splitting the difference between these two computations, we arrive at a span of A.D. 1102-1235. We designate this as the "Early to Mid Pueblo III Group" and note that dates from the Gallina sites fall at both extremes.

The second group is bracketed in the extreme by an A.D. 1183 archeomagnetic date and an A.D. 1375 one from LA 10794, both of which Wiseman (1980) disputes on the basis of ceramics. The mean of all these dates is A.D. 1302 (S.D. 63.8 years). Because no cutting dates are available, we will simply use this mean date, the cluster of vv dates in the early 1300s, and the presence of some Rio Grande Glaze A ceramics to characterize these as the "Pueblo III/Pueblo IV Transition Group."

Table 8. Phase Designation of Sites and Dates

Dates (A.D.)	Phase Name	Area	Source
1100-1200[1]	Valdez	Taos	Wetherington (1968)
1100-1250[2]	Gallina	Gallina	Cordell (1979)
1075-1150[3]	Apache Creek	Reserve area	Berman (1979)
1100-1325/late PII to early PIV	Glencoe, late	Sierra Blanca/ Capitan	Kelley (1966)
1100-1200[3]	Early Tularosa	Reserve area	Schroeder and Wendorf (1954)
1100-1200	Willow Creek	Point of Pines	Wendorf (1950)
PIII or PIV	not named	Cochiti, Galisteo, and Albuquerque areas	See Appendix 1

Notes: 1. Disputed. Loose (1974) prefers 900-1125 based on traces of Red Mesa Black-on-white.

2. Tree-ring dates from various sites in the district range from A.D. 1059-1300 (Cordell 1979:46) - these are primarily surface structures.

3. There is some lack of agreement over definitions and precise time of the Apache Creek Phase. Early Tularosa is sometimes used as an alternative designation.

Several other comments should be made. First, four of the six archeomagnetic dates fall between A.D. 1183 and 1200 (through Wiseman 1980 questions one). Considering the geographic spread of these from Taos to Sierra Blanca, this is striking. Second, no date published falls between A.D. 1245 and 1304. Basically, this gap represents the late Pueblo III period to which most of the large masonry pueblos in each of these districts have been dated (including masonry units at Site 616, Mariana Mesa, dated 1236c-1286vv; see McGimsey 1980). In the three sites with dated pairs of pithouses, data suggest that those pithouses are not even roughly contemporaneous at two of the three sites. There are important differences between sites in these two temporal groups. Variations in site size, elevation, ceramics and subsistence are discussed below.

Site Setting and Elevation

Surprisingly few details about site setting are included in excavation reports. Many of these pithouse sites lie along stream courses and many are linearly arranged (see Figure 30) merely because they lie along highway right-of-way salvage projects. Most of these 52 excavated sites are in forest areas, that is, in either higher margins of the pinyon-juniper zones or in mixed ponderosa (Transition Zone). A smaller number are found in drier, lower elevation zones, primarily along permanent streams.

The elevational data tell a more concise and surprising story. Again, a surprising number of site reports do not mention actual elevation, so we have had to estimate in many cases, using USGS quadrangle sheets.

The mean elevation of all 52 excavated sites is 2131.72 meters (S.D. 233.58 meters). The 45 of these for which there are reliable elevational data and also data on pithouse depth appear in Table 10. These sites fall into five distinct altitude groups separated by breaks in site elevation (Table 11). Sites in Altitude Group 1 lie between 2353 meters and 2514 meters: Group 2, the bulk of the sites, lies between 2085 meters and 2286 meters. Group 3 lies between 1951 meters and 1981 meters. The Point of Pines site (Arizona)

Table 9. Dated Late Pithouses

Site No.	Dates	Region
LA 11843[1]	941vv and 1101vv	Gallina
AR-03-01-02-02	1230 (tentative)	Gallina
Bg 50	1025vv - 1245vv	Gallina
LA 11850 (2 pits)	1183r - 1231r	Gallina
	1235rb	
TA 34	A 1190+20	Taos
Jewett Gap	1127B - 1159B (repair?)	Reserve
LA 2315 (2 pits)	A 1200+16	Sierra Blanca
	A 1100 or 1360+24[2]	
LA 10794 (2 pits)	1304vv / A 1183+32[3]	Albuquerque
	A 1375+42[4]	
LA 70	1327++vv and 1305vv	Cochiti/Santa Fe
LA 6455	1318vv	Cochiti/Santa Fe
LA 12522[5]	A 1190	Cochiti/Santa Fe

Notes: 1. Seaman (1976) places occupation in the early A.D. 1100s.

2. The archeomagnetic curves cross at both dates - we favor the earlier date since no Rio Grande Glazewares are found in the ceramic assemblage.

3. Wiseman (1980) finds this archeomagnetic date too early and feels it unreliable.

4. Wiseman (1980) finds this archeomagnetic date too late and feels it unreliable.

5. There is a late PIV component at the site, including an undated subterranean room, but this date, from Feature 2, contained no Rio Grande glazes in the fill below the roof and a PIII designation is suggested.

is the lonely occupant at 1890 meters and we decline to assign a Group designation. Group 4 sites lie between 1713 meters and 1798 meters. Finally, Group 5 sites lie between 1548 meters and 1622 meters.

Table 11 shows that three-fourths of the site population lies above 2085 meters. Of interest to chronology, the only site lying above 2085 meters and having Rio Grande glazewares is LA 3334 in the Angus area (Sierra Blanca district). As a generality, the pithouse sites in the Sierra Blanca district are not in notably high elevations, as they are in the Taos, Gallina, and Apache Creek areas.

The lower elevation sites include all of those with late absolute dates. The placement of LA 12522 (Cochiti Reservoir, archeomagnetic A.D. 1190) and LA 4955 in the lower elevations suggests that sites in lower settings are not uniformally late, though both also have Pueblo IV or Pueblo V components.

The late pithouse villages in this sample are found from 1548 meters to 2515 meters in elevation in western New Mexico. Additional data would likely increase this range somewhat since a few Gallina sites are allegedly at higher elevation. But, relatively few sites lie in the 1929-1981 meter zones. This pattern is consistent with general data from the Middle Rio Grande (Stuart and Gauthier 1981:55). Hevly (this volume) suggests a possible explanation for this.

More to the point, we may characterize our

Table 10. Number of Pithouses by Elevation - 45 Sites*

Group	Elevation in Meters	Excavated Pits	Sites
1	2530		
	2484	1	LA 9200
	2438	5	Jewett Gap
	2393	2	LA 9203; 9204
	2347	3	LA 9206; 9207; 9209
2	2301	0	0
	2256	4	TA 1; Bg50; LA 11843; S268
	2210	19	Mar. Mesa; TA 20; S83; S103; TA 32; S95; S104; TA 18; TA 10; S102; No no.
	2164	9	02-02; 02-03; 02-32; 02-62; LA 9201
	2118	3	TA 112; LA 11850
	2073	13	LA 16297; LA 3334; LA 4986; LA 2315
	2027	0	0
3	1981	0	0
	1935	10	LA 3333; LA 2949; LA 3260
	1890	1	Point of Pines, AZ
	1844		
4	1798		
	1753	12	LA 10794; Bonnell
	1707	2	LA 2000
	1661	0	0
5	1615	0	0
	1570	8	LA 70; LA 6455
	1548	1	LA 4955

*LA 5378 and 5380 not plotted because no pithouse depths are available.

Table 11. Altitude Groups Separated by Breaks in Site Elevation

Altitude Group	Elevation in Meters	No. Sites*	Percent
Group 1	2353-2514	7	14
Group 2	2085-2286	31	61
Group 3	1951-1981	3	6
Group 4	1731-1798	6	12
Group 5	1548-1622	3	6
Total		51	

*excludes LA 12522

"Early to Mid Pueblo III" temporal group as the high elevation sites (above 2095 meters) while the "Pueblo III/ Pueblo IV transitional" group is associated with lower elevational settings. Several sites in the mid elevations (LA 3334, Mariana Mesa Site 616) have Heshotauthla Polychrome, but no Glaze A wares. Several others have St. John's Polychrome, which is discussed below. To formalize these impressions we plotted the dated sites by elevation (except LA 12522) and date in Table 12. Linear regressions were then computed to determine the relationship between date and elevation.

Because of the uncertainties occasioned by multiple dates we did three regressions; we first used the "early" dates for each site; we then computed with the late dates for each; finally we used the average of multiple dates. The results are most interesting (Table 12). Whichever regression one favors, it is clear that as elevation increases, the dates become earlier. Put more sensibly, site elevation decreases markedly from A.D. 1100 to 1325. Since the relationship is clearly the strongest for the earlier (highest) and latest (lowest) sites, we know less about sites dating between the A.D. 1200+ and A.D. 1300.

The graph in Table 12 suggests an hiatus in pithouse construction between A.D. 1245 and 1300 and/or a substantial dislocation in site altitude/geographic location not represented in our sample. For the moment we favor the interpretation that pithouse construction was discontinous in the higher elevations between roughly A.D. 1250 and A.D. 1300 - a period of intense construction at large Pueblo III masonry pueblos. That is, the high elevation Early/Mid Pueblo III group and the Pueblo III/Pueblo IV transition group represent two distinct, temporarily discontinuous, construction and settlement episodes. In order to further support this interpretation we will return to ceramic data in a later section and isolate those sites containing St. John's Polychrome which is said to date from A.D. 1175-1300. For the moment let us turn to site size.

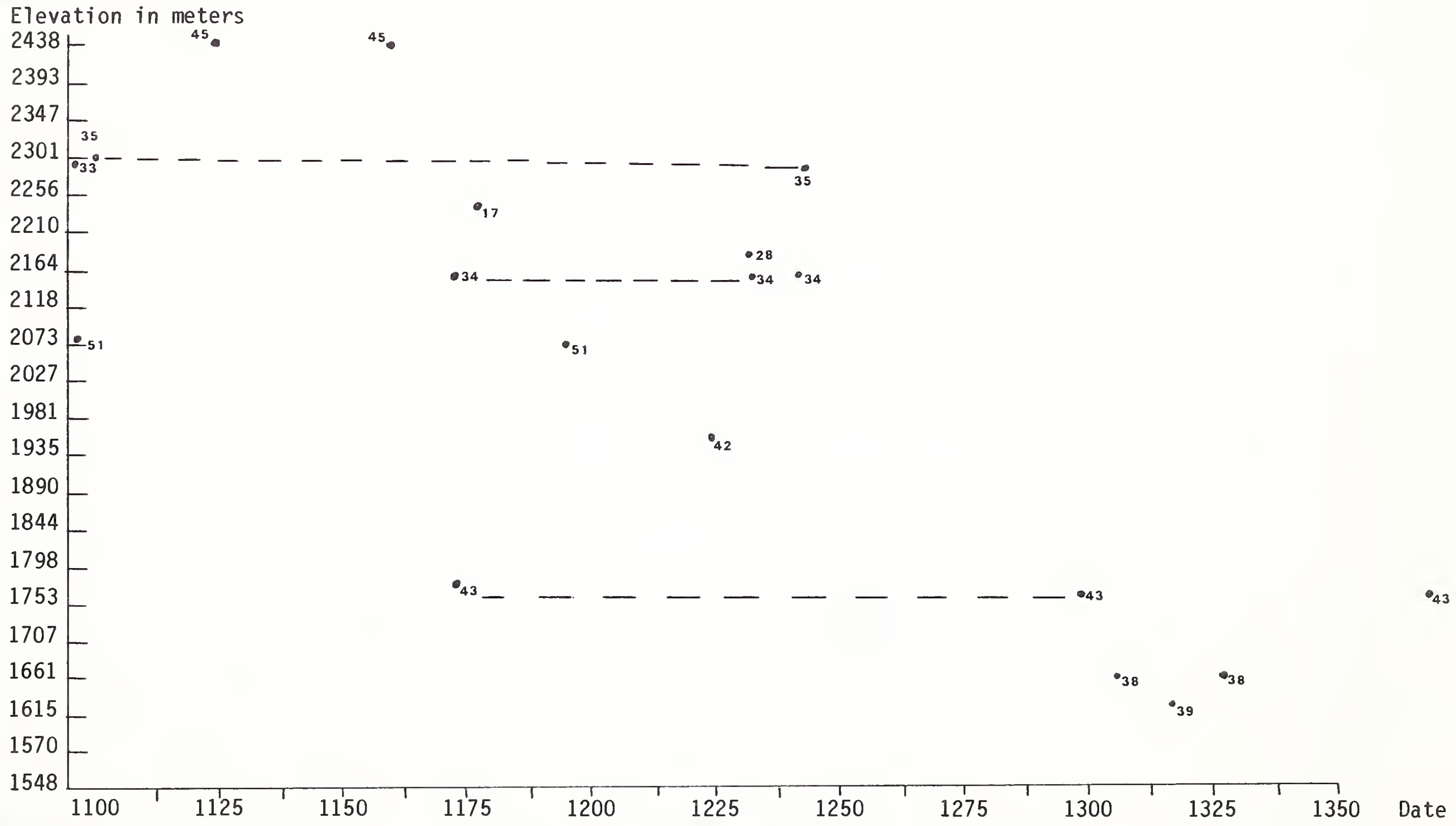
Site Size

Unlike most earlier pithouse villages (between A.D. 500 and 900), these late pithouse sites are most often characterized by one or two isolated pithouses scattered about the wooded uplands. This is particularly true of the highest elevations (above 2195 meters); this, however, is not the only apparent pattern. Notable distinctions in size occur between the "Early/ Mid Pueblo III" site group and the "Pueblo III/Pueblo IV Transition" group.

As reported, these sites range in size from one to twenty pithouses. Of all the sites in our sample, 60 percent have only a single pithouse. Though single pithouse sites are found in all our sample districts, the pattern is particularly strong in the Gallina and Taos areas. Table 13 summarizes site size and dates, where known, for 49 sites.

Notice that only one site (Jewett Gap) with more than four pithouses is situated above the mean elevation (2120 meters) for the entire sample. The mean number of pithouses for all sites is three. Of those sites that exceed mean size only two (Jewett Gap and TA 18 near Taos) lie above the mean elevation. Except for these two

Table 12. Elevation and Date of all Dated Sites



Early Dates: N14
Corr. - .7583
(99 - 99% con @
12df)

Y points
mean = 2073m
S.D. = 265.77m
Var = 212441.15

X points
mean - A.D. 1210
S.D. = 78.3 yrs
Var = 5630.66

Late Dates: N14
Corr. - .7345
(99 - 99.9% con @
12df)

Y points
mean = 2049m
S.D. = 263.57m
Var = 210402

X points
mean = A.D. 1250
S.D. = 83.6 yrs
Var = 6455.17

Earliest vv Dates
Slope - 5.235
Y int = 12938.54
Corr. - .721

Y points
mean = 2055.7m
S.D. = 263.6m
Var = 210483.6

X points
mean = A.D. 1182
S.D. = 119.02 yrs
Var = 13078.17

Averaged Dates: N13
Corr. - .8054
(99.98% con @ 11 df)

(Numbers in graph correspond to site code numbers in Table 18)

Table 13. Number of Pithouses Per Site
(as reported in excavation reports)

No. Pithouses	Site Date	No. Sites	Total No. Pithouses
1		29	29
2		5	10
3		2	6
4		4	16
5	1127B and 1159 BR	1	5
6	1305vv and 1327++vv	1	6
7	1304vv 1100's?	2	14
8	1200±16 and 1100 or 1360±24	1	8
9	1225B	1	9
10	1318v	1	10
14	?1100s and 1200s	1	14
20	?1100s and 1300s	1	20
		49	147

Ave. no. pithouses/site = 3

Ave. without highest and lowest/site = 2.6

Ave. for northern N.M. = 79 pits 35 sites = 2.25
less Glaze A sites = 56 pits 32 sites = 1.75

Ave. for southern N.M. = 68 pits 14 sites = 4.85
less Glaze A sites = 44 pits 12 sites = 3.6

Ave. for Glaze A sites = 46 pits 5 sites = 9.2

Sites containing Glaze A and Heshotauthla Polychrome
LA 3334 Glaze A Red and Heshotauthla
LA 70 Glaze A Red 1327++vv; 1305vv
LA 6455 Glaze A 1318vv
LA 10794 traces Glaze A 1304vv; A 1183±32 and 1375±45
Bonnell traces Glaze A
LA 3333 Heshotauthla Polychrome
Mariana Mesa 616 Heshotauthla Polychrome

site, the other 11 which are larger than average are all either at mid elevations in southern New Mexico (1676-1981 meters) or belong to the lower elevation "Pueblo III/Pueblo IV Transition group. That is, site size increases through time and in the warmer, lower elevations. Judging from ceramic evidence, the increase in site size occurs slightly earlier in warmer, southern New Mexico. This is not surprising if site size is related to agricultural productivity and length of the growing season. The five sites having Glaze A wares (Pueblo III/Pueblo IV Transition group) average 9.2 pithouses per site-three times the average for the entire sample.

Table 14 presents site size by the elevation groups identified earlier. Regressions were also computed (as appear at the bottom of the table) to formalize our impressions. All three regressions confirm the relationship between lower elevation and larger site size at 80 percent confidence or better. These results are not very impressive. Nonetheless, we note that sites in atypically low (1622 meters or less) settings again become smaller. It would appear that they are somehow not optimally located. The linear regression may not properly express the relationship

Table 14. Average Size of Sites by Elevation Groups*
(grouped by breaks in elevation)

Group	Elevation	No. Sites	No. Pits*	Ave. Size/Group
1	2353-2515m (ave. 2434)	7	11	1.57 (Jewett Gap = 5 pits)
2	2085-2286 (ave. 2185)	26**	48	1.84 (TA 18, LA 3334 have 4 pits each)
Higher group - 1.78 pits per site; range 1-5				
3	1951-1981 (ave. 1966)	3	20	6.66
---	1890	1	14	14 (1 site - Point of Pines)
4	1713-1798 (ave. 1756)	3**	29	9.66 (Bonnell has 20)
5	1548-1622 (ave. 1585)	3	18	6
Lower group - 8 pits per site; range 1-20				
Totals		43	131	3 ave. for all

A) Regression N=6 (includes Point of Pines)	B) Regression N=4 (excludes Glaze A sites)	C) Regression N=5 (excludes Point of Pines)
Corr. - .607	Corr. - .8453	Corr. - .7937
(80% con @ 4 df)	(80%+ con @ 2 df)	(80-90% con @ 2 df)

*Includes both excavated and unexcavated pithouses for sites where total pithouse components are known and elevation is confirmed (excludes eight sites).
**Excludes LA 5820, LA 5640, TA 34 - incomplete data at time of compilation.

between site size and elevation.

Pithouse Depth

Farwell (1979) previously proposed that pithouse depth varied with site elevation, with pithouses becoming deeper as altitude increased. This proposition is based on the notion that the insulative qualities of deep pithouses would moderate the effects of cold site settings as extremes of high elevation were reached. Here, we pursue that idea, with mixed results.

Most of the shallow pithouses at lower elevation are rectangular, regardless of where they are located. Surprisingly, both round and rectangular deep pithouses often appear in the same locale whether in northern or southern New Mexico. This violates ordinary assumptions that rectangular construction is Mogollon, while circular is Anasazi. On the other hand, this architectural "mixing" has been cited, from time to time, as evidence for

migration.

The Gallina pithouses, however, are generally circular, and more often isolated. (For one possible explanation see Stuart and Gauthier 1981, Ch. V.)

Table 15 presents average pithouse depth by elevation group. Again, results are mixed, since so few excavation reports noted pithouse depth from the original occupation surface. Here we were forced to use pithouse depth from excavated surface knowing that it introduces variance from post-depositional erosion and aggradation. Nonetheless, until we are able to retrieve enough original depth from the literature to generate a realistic corrective factor (comparing original to excavated depths) it is safe only to say that some pithouse depths at higher elevations may be overstated here. The mean depth of all 92 pithouses is 1.68 meters with a standard deviation of .74 meters. Minimum depth was .3 meters and maximum was 3.0 meters.

Even in their present form the data are suggestive. It is clear from Table 16 that average pithouse depth decreases as altitude decreases. Again, linear regressions were run from these data. Using the lowest elevation in each group to average pithouse depth a correlation of +.9435 (90 percent+ confidence) was obtained. Using the average, or mean, elevation of each altitude group a correlation of +.9486 (95 percent confidence) was obtained.

On the other hand, pithouse depth did vary significantly within a number of sites. As we noted previously, several sites had pairs of dated pithouses that were not contemporaneous. We point out that in both cases (LA 2315 and LA 10794) the non-contemporaneous pairs of pithouses were of remarkably different depth. We note also that at LA 11850 where the dated pair were of the same depth, the pithouses fall only 4 years apart.

Letting ourselves be guided by the more general pattern, which indicates that the cold of high elevation is offset by increased pithouse depth, we may propose an explanation for intrasite depth variance. If one accepts the idea that pithouses of substantially different depth in a given site are not contemporaneous, then a general climatic warming trend could account for very shallow pithouses in high elevation sites, whereas a notable cold period could account for deep pithouses in the lowest elevations.

In order to properly evaluate this proposition one would have to establish that pithouse depth varied systematically through time in a given altitude strata. Pithouse depth, elevation, and dates have been graphed in Table 17. The only abnormally deep pithouses we have at low elevation are at LA 12522 (A.D. 1190) and at LA 70 (1305 vv and 1327++vv). Abnormally (more than one standard deviation) shallow pithouses at sites above 2085 meters occur at TA 1 which lost part of its original depth when Pot Creek Pueblo was built on top of it, and at several sites in the Reserve and Sierra Blanca districts where a north/south temperature gradient could account for part of the variance. In short, we cannot yet make a refined case for climatic change on only intrasite variance in pithouse depth, particularly since we have so few reliable depths to work with.

Other investigators (Stafford and Rice 1979) have suggested that shallow pithouses in the higher elevations are only occupied in the summer season. This is, of course, a plausible explanation. Nonetheless, we suggest that it would make no sense to invest labor in a summer season pithouse 10 meters away from a deep winter season one since the thermal properties of the deep pithouse would buffer extremes of both heat and cold.

In spite of difficulties, the data suggest that a site's date and pithouse depth are generally related. In Table 17 these data are presented. As before we tested for correlation using early dates, late dates, and averaged dates for each site. Using the early dates did not yield a significant correlation (-.302), as these were influenced by the two very early "vv" dates at Gallina sites (941vv and 1025vv). However, the late dates and averaged dates yielded correlations of -.465 (90 percent confidence at 12df) and -.404 (80-90 percent confidence at 11df), respectively. Using the "rb" or archeomegnetic dates yielded similar results. However, sites with dated pairs of pithouses had a -0.0631 correlation of depth to date, where the relationship nearly vanished.

We may conclude then that: (a) pithouse

Table 15. Average Pithouse Depth* by Elevation

Elevation Group	No. Pithouses	Ave. Depth (mean)	S. Dev. (sample)
1. over 2353m (2434 ave.)	11	2.063m	.473 (.451 pop)
2. 2085-2353m (2185 ave.)	47	1.938m	.650 (.643 pop)
3. 1829-2085m (1940 ave.)	11	1.668m	.661 (.630 pop)
4. 1548-1829m (1670 ave.)	23	.982m	.603 (.590 pop)
Total Population	92	1.682m	.741 (pop)

1) Linear Regression on four groups: lowest elevation in group
Corr. +.9435 (90-95% confidence level)
mean depth 1.66m

S. Dev.	.4828m
Var.	.174
Mean Alt.	1,954m
S. Dev.	344.75m
Var.	292455.6

2) N=4: average elevation
Corr. +.9486 (about 95% conf)

*Depth from present ground surface

depth decreases systematically with elevation, (b) the later sites are generally shallower because they are also in lower elevations, and (c) intrasite variability in pithouse depth and variability in depth within an altitude zone are not adequately explained, though we have tentatively suggested changing climatic circumstances. Generally, pithouse depth does seem to be conditioned by the external temperature conditions which prevail in different altitude zones, but the data are imperfect and obscure further interpretation.

Subsistence

As in other respects, subsistence data are only inconsistently reported from excavation. Nonetheless, there are two important trends in subsistence which are associated with the high elevation sites in our sample.

First, corn recovered from the higher elevation pithouses is consistently described as distinctive in excavation reports. The corn found in these sites is almost exclusively small-cobbed and small-kerneled. Though there is substantial variation in row numbers (8 to 16 rows being reported), the most frequent appears to be 10-12 rowed.

In the Taos district Blumenschein (1958) reports corn (described by Cutler) as similar to that grown in Taos Pueblo today-like Pima-Papago corn. That is, it is a variety like "Basketmaker" corn rather than the big shanked indented Pueblo varieties. This characterizes the corn in the Arroyo Hondo district. Leubben (1968) reports 12 rowed corn from TA 32 having a kernal thickness of 3.98 mm and width of 7.7 mm (conversion from inches ours). This falls within the range of Blumenschein's material. Thus the 2195-2310 meter

Table 16. Elevation and Pithouse Depth

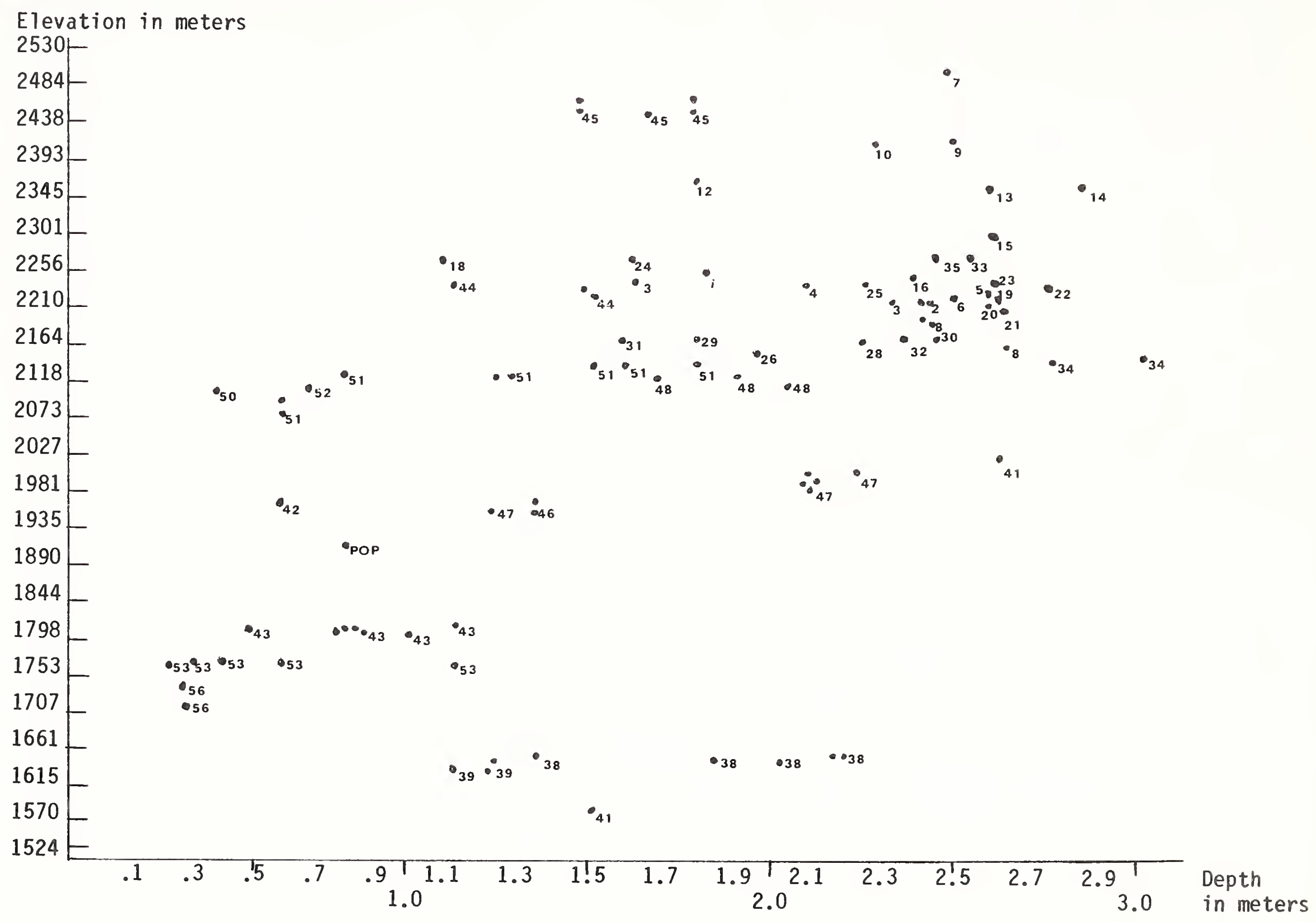


Table 17. Dated Pithouses/Depth, Elevation, Site Size

Site No.	Dates	Ave. of Dates	Pithouse Depth	Elevation	No. Pits
LA 11843	941vv and 1101vv	1021	2.5/2.1	2286m	1
AR-03-10-02-02	1230	1230	1.8/	2170m	1
Bg 50	1025vv- 1245vv	1135	2.4/	2286m	1
LA 11850	1183r- 1231r	1207	2.99/2.0	2134m	2
	1235rb	1235	2.7/2.0	2134m	
LA 70	1305vv and 1327++vv	1316	2.10/	1622m	6
LA 6455	1318vv	1318	1.1	1615m	10
LA 10794	1183+32 and 1304vv	1243	.40	1780m	7
	1375 +45	1375	.90	1780m	
LA 3333	1225B	1225	.60	1964m	9
LA 2315	1200+16	1200	1.2	2097m	8
	1100 or 1360+24	1230	.60	2097m	
Jewett Gap	1127B and 1159B	1143	1.5	2469m	5

Sites with dated pairs only

N=6

Slope	-0.00074
Int.	2.393
Corr.	-0.631
Depth:	mean = 1.465m
	S.D. = 1.10m
	Var. = 1.02m
Date:	mean = 1240 A.D.
	S.D. = 93.4
	Var. = 7270

Early Date N=14

Slope	.00222
Int.	4.27
Corr.	-.302
Y data:	mean = 1.59
	S.D. = 877
	Var. = .710

Ave. Date N=13

Slope	.003944
Int.	6.4164
Corr.	-.404 (80-90% conf @ 11df)

Best Dates (pairs of R or B dates averaged)

N=6

Slope	.00733
Int.	10.77
Corr.	-.6187
Depth:	mean = 1.415m
	S.D. = .99m
	Var. = .819m
Date:	mean = 1277 A.D.
	S.D. = 86.39
	Var. = .819

Last Date N=14

Slope	-0.00514
Int.	8.054
Corr.	-.465 (90% conf @ 12df)
Depth:	mean = 1.599m
	S.D. = .877m
	Var. = .710m
Date:	mean = 1254 A.D.
	S.D. = 79.33
	Var. = 5810.39

elevation sites in the Taos district, may have used a distinctive variety of corn in the colder, higher settings, as does Taos Pueblo, to this day.

In the Gallina district (Ford n.d.) corn at LA 11850 varied from 8-20 rows with 12 rowed the most common. Kernel width averaged 6.9 mm and kernal height 4.1 mm! This is indeed small kerneled. At Bg 50, Green (1956) reports that elk, deer, jack-rabbit and prairie dog were found. In personal communication (1980) J. R. Gomolak reports corn found in the Stone Lake/La Jara region to be "quite unlike Puebloan corn;" it is small and thin shanked.

Holbrook and Mackey (1976 and cited in Cordell 1979:49-50) argue for increasing drought conditions in the Gallina between

A.D. 1250 and 1300. They cite evidence of decreasing cob and kernel size and decreasing number of rows as evidence of xeric conditions. We point out that the small cobbed/kerneled corn is also found in sites pre-dating A.D. 1250, and throughout the highland districts.

At Mariana Mesa (McGimsey 1980) small cobbed (2.5, 5.0 to 7.6 cm in length) corn was frequent in the excavated material. These data are summarized in appendix form (Ibid:295) and the small corn is characterized as "Chapalote-like." Pithouse Rooms D5, E1 and E2 contained, with three surface rooms, "most of the animal bone, chips, and flakes recovered."

In the Apache Creek district to the south of Mariana Mesa corn from LA 2949 (Phase dates A.D. 1075-1150?) was described as "stunted" (Peckham, Wendorf, and Ferdon 1956).

In the Sierra Blanca district Kelley (1966) described corn at the Bonnell site as like that at Block Lookout; i.e., small-sized cob corn varying from 8-16 rowed (mostly 10 rowed). This, she suggested, represented corn of an "earlier vintage" than would be expected for a late Pueblo III (A.D. 1200-1300+) site. Her analysis of late Glencoe site materials indicates notable quantities of faunal remains from big game, a high proportion of projectile points, and only a modest ground stone assemblage. These all suggest substantial reliance on hunting and gathering and lesser emphasis on corn agriculture.

The data are less clear from other sites in the Sierra Blanca district. LA 16297 (Farwell and Oakes n.d.) only one cob of 10-rowed corn was found and it tended towards large kernels and at LA 2315 one cob of 12-rowed corn was recovered. Corn and pinyon were also recovered from LA 3334 (Site Survey Records) but no analysis is currently available.

Finally, in the Rio Grande district corn was recovered from LA 70 (Snow 1976). The corn was not separated by rooms for discussion, but Snow characterized two varieties. The first of these is common to prehistoric sites in the Rio Grande, while the second (we presume from very late components) appears to be a 16-rowed variety introduced by the Spanish. At LA 6455 (Lange 1968) analyzed corn was not correlated with individual pit rooms, but no unusual characterization of it is offered. In short, our data on corn from the Pueblo III/Pueblo IV transition group pit rooms in lower elevations in quite sketchy, but it seems to have generated no series of characterizations like that for the higher elevation Pueblo III sites.

Corn described as "small", "stunted," "archaic", or "Chapalote-like" or like "Pima-Papago" is a dominant feature in the mid to high elevation pithouse sites throughout the highlands of New Mexico. This small-cobbed corn appears throughout the A.D. 1100-1300+ temporal span of the highland sites - sites which substantially pre-date the A.D. 1250 drought period focused on by Holbrook and Mackey (1976). Moreover, the distinctive variety of corn grown at contemporary Taos evidently has survived both periods of drought and wetter conditions. These characterizations all suggest a distinctive highland agricultural strategy. Is this small-cobbed corn a varietal adaptation to the colder conditions and shorter growing season of the highlands? More on this later.

Large game also appears to have played an unusually important role in highland subsistence, for remains of large game are characteristic where the data are available. One exception is the Jewett Gap site (Bullard 1950) at 2469 meters where large fauna were not well-represented and a robust groundstone assemblage was present.

This emphasis on larger game is in marked contrast to faunal assemblages found in the Late Pueblo II (A.D. 1000-1125) period in the Classic Mimbres and Chacoan sites, particularly in the Mimbres and Gila River areas (see LeBlanc and Whalen 1979; Stuart and Gauthier 1981, especially Chapter V). Late Classic sites are all characterized by remains of rabbit, rodents, small bird species, and so on, while deer or antelope remains are notably scarce. Jelinek (1967) has noted the same pattern for the Mesita Negra phase sites (Pueblo II, temporarily) in the Middle Pecos Valley to the east of Chupadero Mesa. There the faunal assemblages included many remains of rodents and turtles, with practically no larger species being found.

Nearly all of these Pueblo II period excavated sites are in elevations between 1524 and 1981 meters. Even these higher

classic Mimbres and Chacoan sites are in rather dry unforested upland settings by comparison with the Pueblo III pithouse settings in our sample.

The "Pueblo III/Pueblo IV Transition group" cannot yet be adequately characterized here, subsistence wise. But no pattern which is strikingly unlike early Pueblo IV adobe/masonry sites has apparently attracted attention. This is an important area for future research since striking settlement changes take place about A.D. 1300, and one would expect change in subsistence as well.

Burials

Information on burials is noticeably poor for this series of sites, but, again, there are two interesting features of burials in the higher elevation sites.

In the Taos district, Green (1963) reports a number of burials evidencing violent deaths: Burial 3 (skull crushed); Burial 7 (broken ribs); Burial 9 (infant-crushed skull); Burial 10 (neck broken, arms crushed); Burial 12 (upper vertebrae and scapula crushed); Burial 13 (infant-broken neck); and Burials 16 and 18 (scattered-missing bones). These burials are from site TA 18, among others. Blumenschein (1958) also reports that at Taos site 103 several adults and one child had been decapitated. One head was found in the ventilator shaft, and the site had been burned.

A number of scholars have commented on the pattern of burned sites and violent deaths in the Gallina district. Some think this portrayal to be generally overdramatized. Yet Dick (1976) reports that no burial is 100 percent intact in the "AR" series of sites. There are remains of dismembered children as well as adults and many bones evidence cutting striations from dismemberment. In Dick's entire burial population, 60 percent of the adults and 38 percent of the children show evidence of violent death. Perhaps the characterizations of local conflict in the Gallina area are accurate.

At Mariana Mesa McGimsey (1980) notes that a burial from Room EI at Site 616 showed evidence of slight cranial battering. In southern New Mexico we have evidence for malnutrition in the Sierra Blanca district, during the 12th century (Farwell and Oakes, n.d.). We doubt that this is remarkable.

In the Taos district, Loose (1974) reports that the skeletons were Pueblo physical types characteristic of the Southwest Plateau. Peckham and Reed (1963) report a burial at LA 3643 in the Taos district to be of the same Pueblo-Plateau physical type. In the Gallina district, however, Dick (1976) states that the skeletons are not of Puebloan peoples; rather, they are "Plains" physical types.

Let us tentatively conclude that, in the upper elevations of northern and central New Mexico, the early to mid Pueblo III sites show roughly contemporaneous evidence for both "Pueblo" and "non-Pueblo" occupants. Second, it seems clear that social conflict was a feature of the 12th and 13th centuries in these districts. We remind the reader that Gallina Pithouse sites like LA 11843 are notable for their surrounding stockades.

Ceramics

The Early to Mid Pueblo III Pithouses

Ceramic data from these excavated pithouses are generally quite complete. Yet, the specifics of ceramic distribution and the accurate dates for many types are only imperfectly known. In spite of this several trends are striking.

As a class, the higher elevation sites in each district are conspicuously lacking in intrusives, or tradewares. This is most noticeable for the highest sites in the Taos district, the Gallina district, and the Apache Creek area. Nonetheless, the pattern also holds for the highest sites in the Sierra Blanca districts as well. At pithouse sites, plainwares dominate most ceramic assemblages throughout the highest elevations.

In the Taos area, at Mariana Mesa Site 616, and in the Apache Creek sites, traces of Red Mesa Black-on-white occur as an intrusive. This has caused several investigators (Loose 1974, among others) to argue earlier phase dates for some of these sites. The weight of the evidence, however, suggests that Red Mesa Black-on-white or localized copies, lingered on in the highlands after the A.D. 1125 termination date most scholars cite (Breternitz 1966).

Even then, Breternitz noted that Red Mesa Black-on-white was found as a trade or intrusive ware until the early A.D. 1200s in several areas. Recall that Jelinek (1967) also commented on continued traces of Red Mesa Black-on-white at McKenzie Phase sites in the Middle Pecos Valley. These he dated in the A.D. 1100s to mid-1200s.

Tradewares are more common in the lower elevation pithouse sites, even those presumed to be early Pueblo III. The pithouse/kiva at Higgins Flat Pueblo (tentatively dated to about A.D. 1175-early Tularosa Phase) lists 30 odd ceramic varieties (Martin, Rinaldo, and Barter 1957) of which half a dozen would be considered intrusive. Higgins Flat Pueblo is at roughly 1811 meters in elevation. The situation is similar at LA 2949 which lies at 1963 meters (Peckham, Wendorf, and Ferdon 1956) and which had 40 ceramic types. At LA 4986, in the same general area (Kayser 1972), the number of ceramic types is halved to 20 with only two painted types noted (Wingate Black-on-red and Red Mesa Black-on-white); this site lies at 2088 meters in elevation.

We may characterize the Early to Mid Pueblo III group as conspicuously modest in both instrusive tradewares and in painted wares. This trend appears moderated in those sites with lower elevations than average for the group.

The Pueblo III/IV Transition Group

These lower elevation, later sites also tend to be larger, as we have said. In the majority of these sites painted (or glaze) wares dominate the assemblage. Moreover, most contain some of the Zuni Glazes or White Mountain redwares such as Heshotauthla or Springerville Polychrome. Indeed, Chupadero Black-on-white is also often present. In short, there is altogether more evidence of a geographically robust trade network between the southern and northern portions of the state and with the West.

The St. John's Polychrome Sites

To flesh out our picture of settlement change we focused on St. John's Polychrome in ceramic assemblages (Table 18). This tradeware is dated generally from A.D. 1175 to about A.D. 1300. We felt it might identify sites which fell between the bulk of our "Early to Middle Pueblo III" group and our "Pueblo III/Pueblo IV Transition" group. Ten sites contained St. John's Polychrome, which is rather few considering that St. John's has been characterized as one of the "most widely traded wares in the Southwest" (Martin and Plog 1973).

Most of the St. John's Polychrome is only found in traces at these sites. Though the sample is small, the mean dates of these sites is A.D. 1228.4. We like this, for earlier we identified a Pueblo III temporal group with a mean date of A.D. 1154 and a Pueblo III/Pueblo IV Transition group with a mean date of A.D. 1304. The halfway point between these means is precisely A.D. 1228! This "St. John's" temporal group is clearly mid to late Pueblo III.

Earlier we noted that three was the mean number of pithouses per site for the entire sample of 179 pithouses and 50 sites. The average for the highest elevation groups was 1.87 pithouses per site, while for the Rio Grande Glaze group it was 9.2 and for the entire mid to low elevation groups 8 pithouses was the average. Again, a mean site size of 6.22 pithouses for the St. John's Polychrome group seems to place it between the extremes.

The averaged elevation of the "St. John's" site is 1967 meters, which is below the entire sample mean of 2131 meters and falls precisely into the mid range of elevation. The mean depth of pithouses at these sites is 1.27 meters (S.D. .62), whereas the average for all excavated pithouses is 1.71 meters. This depth is just a bit <u>shallower</u> than might have been expected for the mean elevation of 1967 meters (see Table 15), but it does, indeed, fall between the depths of the mid and lowest elevation groups.

We should also comment that other components at LA 10794 obviously fall timewise into the Pueblo III/Pueblo IV Transition, but we also note that Jewett Gap is dated early for St. John's Polychrome. Wiseman (1980) is likely correct in declining the 1375$\pm$45 archeomagnetic date, but we are uncertain about the 1183$\pm$32; perhaps he's correct there too.

Finally, the majority of these "St. John's" sites also have overlying or adjacent Pueblo III (mid to late) surface masonry

Table 18. St. John's Polychrome in Pithouse Context

Site	Elevation in meters	Date	No. of Pithouses
LA 2949	1963		7
Higgins Flat	1811		1
LA 2000	1719		2
LA 10794	1780	1375±45; 1183±32/ no Rio Grande Glaze in pits	
Bonnell*	1756	(contains Rio Grande Glaze in pits)	20
LA 3333	1964	1225B	9
Point of Pines	1890		14
LA 2315	1890	1200±16	8
Jewett Gap	2469	1127r - 1159b	5
Mariana Mesa Site 616	2225		3
N 10 mean	1967	1228.4 A.D.	6.22
S.D.	237	85.42	4.02

*excluded because of Rio Grande Glazes

sites also have overlying or adjacent Pueblo III (mid to late) surface masonry components. Let us turn to a picture of late pithouse occupations which weaves these varied data together.

LATE PITHOUSE OCCUPATIONS: REFLECTIONS OF PUEBLO III DEVELOPMENT

The great Pueblo II Chacoan network in the San Juan Basin began to lose its magnet effect about A.D. 1125 with the last notable episodes of construction at Bonito Phase sites. Nearly simultaneously with the last construction date at A.D. 1117 the Classic Mimbres system in southern New Mexico began to disintegrate (LeBlanc and Whalen 1979; Stuart and Gauthier 1981).

If one accepts the temporal symmetry of these events, then it is reasonable to suppose that a forceful, and common, change of circumstances was operant in the Southwest at roughly A.D. 1200.

At about this time there is also a reintroduction of pithouse architecture in the highlands of New Mexico. In 1957, Martin, Rinaldo and Barter commented that it seemed strange for pithouses to have again become "fashionable" in the Mogollon country. We have elected to argue here that the force of charging circumstances was also the force behind fashion.

It is clear that as the Chacoan system declined, it collapsed <u>outward</u> from the central San Juan Basin, leaving a trail of late Chacoan Sites and perhaps roads leading to Salmon Ruin, Morris Site 41, and others. At least that trail, like an arrow, is aimed at the heart of the Mesa Verde country and the high, wooded plateaus of southern Colorado. This may also be a period of alleged Chacoan "site intrusions" in the Zuni area (Marshall 1981:25). At the same time, pithouse settlements are again constructed in the wooded Gallina country to the east of Chaco Canyon. Yet no one would argue that the Gallina sites evidence much affinity with late Pueblo II Chacoan characteristics.

The movement of Late Pueblo II basin populations was apparently outward and <u>upward</u> during the early to mid A.D. 1100s. What forces could draw population into both higher elevations and pithouses at this time - populations which were Mogollon, Anasazi, Puebloan and Plains types? It is remarkable that at least some members of several major cultural traditions and racial types responded nearly simultaneously to an urge as specific as a return to pithouse architecture over an area of 181,300 square kilometers. It is

economical to argue climatic change as an important factor.

We suggest from Hevly's chart of tree-ring width (published in Martin and Plog 1973:52) that beginning about A.D. 1100 and ending between A.D. 1200 to 1250 on the Colorado Plateau, it became gradually colder and precipitation became heavier in the winter season (Figure 31). After the early A.D. 1200s it again became warmer and drier, and summer rainfall again increased in dominance just before A.D. 1300 to 1325. These climatic changes, if verified, could largely account for the late pithouse constructions discussed here.

If the Chacoan and Mogollon systems collapsed, in part due to the changing seasonality of rainfall, populations would have moved into the highlands to maximize moisture at higher elevations. Certainly in the Gallina area, and perhaps elsewhere, some non-Puebloan population already occupied the highlands. The evidence for local conflict (burial data) suggests that previously semi-nomadic upland hunters suffered geographic compression as basin populations encroached the foothills of their districts. If this was the case, some would certainly have been induced towards increased sedentism and more intensive subsistence strategies as hunting territory was reduced. This interpretation could be verified if some upland "Archaic" campsites were dated to the first millenium A.D. as they have been in the low elevations of eastern New Mexico. Puebloan population also moved into the highland areas during the twelfth century.

At the higher elevations rainfall is greater, but so is its variance. This creates an unstable agricultural regime in the uplands--one which requires reliance on hunting and collecting. Obviously such a subsistence regime cannot support the same denisty of population as an intensive agricultural strategy with lengthy growing seasons and dependable summer rains. This is particularly so if the low nighttime temperatures of the higher elevations inhibit crop development and reduce yields.

We argue that the corn found throughout the highlands was adapted to a shorter growing season, since it was small and relatively fast maturing.

This implies that it was a special variety. On the other hand, corn is well-known for its plasticity. It may be that the "Archaic" or "chapalote-like" characteristics were caused by low nighttime temperature and/or drought conditions.

It is common to argue that drought conditions favored a movement into the highlands since growing season would have lengthened under warmer conditions. For this reason, the Mesa Verde region has been proposed (Euler et al., 1979) as a refugee area, i.e., a refuge from drought. We generally accept this argument, but the Mesa Verde phase at Wetherill Mesa (Hayes 1964) is dated to the A.D. 1200s, not the 1100s, so this argument does not account for the Early-Mid Pueblo III pithouses in the highest elevations.

In short, there was a forceful shift in settlement to the highlands throughout New Mexico which began in the early 1100s. Though it is possible that rapid population growth during the Classic period merely pushed some groups into marginal settings at high elevations, the evidence favors climatic change. If demographic crisis led to upland settlement, why is there, by comparison, little evidence for local conflict in classic Chacoan and Mimbres sites? Why, indeed, are there relatively few burials at the Chacoan Bonito phase sites?

As low-yielded agriculture combined with hunting-gathering failed to support increasing populations compressed into the highlands, localized conflict became widespread. Both as a response to the cold settings of higher elevations and/or an episode of generally colder climate, about A.D. 1200 pithouse depth reached its maximum and the highest elevations were vacated, never to be permanently reoccupied. The slightly lower (2134-2286 meter) elevations are characterized by small masonry pueblos such as the early Santa Fe Black-on-white sites of Los Alamos.

With the onset of the Great Drought (traditionally dated at A.D. 1276-1299) it became warmer and drier in the late 1200s. This period is marked by indirect evidence for increasing agricultural productivity (i.e., more ground stone in lithic assemblages and greater quantities of corn having varied characteristics). These factors coincide with the late and widely reported, Pueblo III pattern of

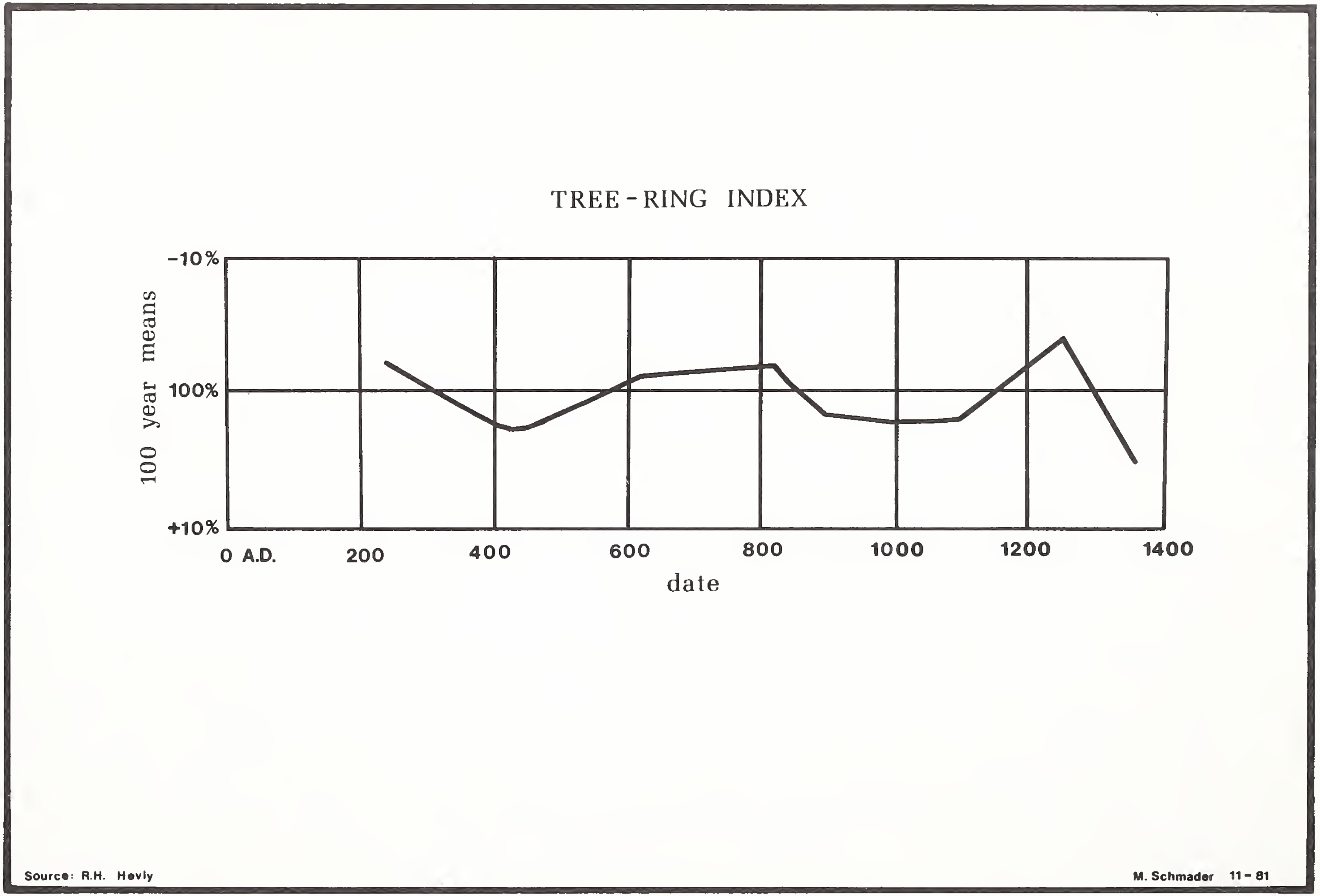


Figure 31. Mean Departures of Tree-Ring Width for the Little Colorado Area.

increasingly large masonry (and adobe) sites in slightly lower elevations (1829-2134 meters). These occupations are represented by the Mesa Verde Phase at Mesa Verde, the late Coalition sites of the Pajarito Plateau in the Upper Rio Grande, the Kowina phase sites at Cebolleta Mesa, the Scribe S phase at El Morro, the large Tularosa phase sites (see McGimsey 1980) in the Reserve district, and, perhaps, the Lincoln phase surface pueblos of the Sierra Blanca district. These are the drought adapted occupations. They were short lived in every area where permanent streams were not present.

It is at this time (A.D. 1125+ to 1300) that settlement shifted primarily to the east slopes of the major highland chains. The Lincoln sites faced primarily east towards Roswell, New Mexico; the Galisteo Basin opens to the east from the Santa Fe Mountains; the Pajarito Plateau faces generally eastward from the Jemez. The east slopes of the Sangre de Cristos from Galisteo to Mora and Cimarron saw the temporary spred of roomblock sites in mid-elevations which were characterized by Taos Black-on-white or Santa Fe Black-on-white (Stuart and Gauthier 1981:303-305).

The masonry Gallina sites on the dryer west slope of the Jemez highlands do not quite survive to the Pueblo IV horizon (A.D. 1300-1325). The Scribe S occupation (about A.D. 1250) at El Morro just to the west of the Continental Divide is abandoned nearly as quickly as it sprange up. As every farmer knows, east slopes are cooler and moister while west slopes are hotter and drier. In most localities, the Gallina folk made a good move assuming cooler, wetter conditions. It is logical to argue that this became a bad move a century later, when it was warmer and drier.

As drought conditions deepened in the late A.D. 1200s yet another settlement shifted emerged. And with this a modest and final episode of pithouse construction took place at the Pueblo IV horizon (A.D. 1200-1325). These pit rooms were generally followed quickly by more substantial construction at the same site. They are probably expedient in some way not yet quite understood. They are, nonetheless, in settings representative of the forceful downhill shift into major riverine settings which characterizes the Pueblo IV period.

The very earliest Pueblo III period (about A.D. 1125-1150) can be characterized as one of pithouse constructions throughout the highlands with at least some small room-block sites constructed in the foothills below. These pithouses are, in fact, the harbringer of the Pueblo III roomblock settlements more commonly discussed in the literature. As the great Pueblo II Classic period basin systems in the San Juan, Reserve/Quemado, and Mimbres districts failed demographically and economically, so too did trade in ceramics collapse. The early Pueblo III pithouse sites in our sample reflect this quite clearly. This phenomenon also has been noted for the late Pilares phase (about A.D. 1100) in the Cebolleta Mesa district (Ruppe and Dittert 1952, 1953).

Certainly surface pueblos were still constructed, but as population compressed into the higher districts pithouses became a dominant architectural type there. The majority of these pithouse sites were small and scattered. Subsistence depended heavily on hunting and gathering. Peak dates were A.D. 1154-1184, elevations averaged 2185 meters, and settlements were generally smaller than three pithouses, which averaged over 1.7 meters in depth.

Later in the Pueblo III period (about A.D. 1200-1250) pithouse sites were located in lower elevations, averaging 1967 meters. Trade throughout the highlands in types such as St. John's Polychrome and Chupadero Black-on-white increased markedly. Site size also increased to an average of about six pithouses and pithouse depth decreased to an average of just over 1.2 meters. The mean date for these sites was A.D. 1228. There was then, apparently a temporal and locational discontinuity (1245vv-1301) in pithouse construction. Finally, there was expedient pithouse construction about A.D. 1300 in Early Pueblo IV site settings-generally lower elevations along major streams. These latter sites contain Rio Grande Glaze A and, occasionally, Heshotauthla Polychrome. They average 1805 meters in elevation and nine pithouses in size. Several also have Pueblo IV room-blocks overlying these.

We do not yet have an unimpeachable explanation for those changes in settlement and architecture which occurred between A.D.

1100 and 1300. Nonetheless we favor the idea that shifts in the seasonality of rainfall and temperature changes contributed substantially. In the early 1100s demographic pressure from Pueblo II expansion could account for movement into agriculturally marginal upland settings; we do not see how demographic pressure to utilize these highland settings was sustained after the abandonment of most classic Chacoan and Mimbres sites in the mid 1100s. Burial data suggest that local conflict was a feature in the high elevation sites, particularly during the 1100s. Burial data, distinctive architecture and assemblages, as well as lack of integration into Chacoan and Mimbres ceramic trade, suggest that non-related populations already occupied the highlands in several areas during the early to mid 1100s. Agriculture was augmented by hunting and gathering throughout the highlands, and few sites show evidence of continuous occupation for any length of time.

Near the terminus of the Pueblo III period, the majority of sites were relatively large unit pueblos in mid elevation settings. The "heyday" of these falls roughly between A.D. 1240 and 1280. Elevations averaged about 1981 meters, there was increased evidence for high-yield agriculture, and ceramic trade was robust. Since these sites violate no classification dicta they are well-known to us in the Pueblo III period literature.

Once archeologists recognize that upland pithouse villages were an important feature of the A.D. 1100-1300 period, data obtained from these will be more consistently woven into interpretations of Pueblo III period development. Until more usable data are available, we can only conclude that life was hard, damned hard, during these two centuries and selective forces were intensive, if not sometimes brutal.

INVESTIGATIONS OF PREHISTORIC REMAINS AT HIGH-ALTITUDES IN THE SACRAMENTO MOUNTAINS OF SOUTH-CENTRAL NEW MEXICO

John B. Broster and Bruce G. Harrill

INTRODUCTION

Variability of depositional patterns of prehistoric materials at high altitudes in the southwestern United States is a subject which has seldom been systematically examined. In 1978, David E. Stuart proposed a research strategy to systematically examine and attempt to quantify the variability in artifact density and type at high altitudes. His research proposal was part of a project design prepared for the establishment of the Forestry Archeological Program of the Albuquerque Area Office of the Bureau of Indian Affairs. In this paper the prehistoric site data recovered from that program's sample survey of commercial forest areas of the Mescalero Apache Indian Reservation is used to test Stuart's proposed high-altitude research strategy.

The archeological sample survey of commercial forest lands on the Mescalero Reservation was conducted in the spring and summer of 1979 by the Forestry Archeological Program staff. The purpose of this survey was to provide information on site density and distribution to allow long-range cultural resources management planning for future timber sale and forest development activities. The program design was prepared for the BIA under contract by David E. Stuart and published in 1978. That document provided the basis and guidelines for the organization, research orientation, field methods and general conduct of the program.

The Mescalero Apache Indian Reservation is located in Otero County in south-central New Mexico and contains 460,384 acres (approximately 1863 km2) which straddle the middle portion of the north-south aligned Sacramento Mountains (Figure 32). The land on the eastern side of the mountain divide is drained by the Tularosa River and its tributaries. The terrain is mountainous, consisting typically of ridges, steep slopes, and deeply cut canyons. Elevations above sea level range from 4500 feet (1676 meters) along Indian Creek on the west side of the reservation to 13,003 feet (3658 meters) at Sierra Blanca Peak.

The survey was confined to 191,947 acres (777 km2) defined as "commercial forest" according to vegetation type maps prepared by the Bureau of Indian Affairs, Branch of Forestry. Commercial forest consists predominantly of stands of pine, fir, and mixed conifer occurring between 6500 and 9000 feet (1981-2742 meters) and distributed fairly continously throughout the rugged Sacramento Mountain terrain.

HIGH-ALTITUDE RESEARCH STRATEGY

In addition to basic cultural resource management objectives, Stuart (1978) proposed several research objectives for the Forestry Archeological Program surveys. He recognized that these surveys would provide an opportunity to carefully examine the nature and patterning of archeological remains at elevations above 6500 feet (1981 meters). With this in mind Stuart proposed a generalized research strategy which could be executed within the framework of normal procedures for documenting cultural resources.

According to Stuart (1978:27), "The basic assumptions of the proposed research involve the interaction of the environment and human populations in generating archeologically recognizable adaptive patterns." To examine these Stuart proposed three stages of data manipulation to analyze the depositional patterns resulting from human adaptive strategies at high elevations.

Stage 1 attempts to determine what depositional patterns exist at high altitudes by determining the distribution of cultural material in space. This initial data tabulation stage is oriented toward the examination of three propositions:

Proposition 1: As altitude increases, the intensity of human use will decrease.

Proposition 2: As altitude increases, the duration of events, or incidents, of human use will decrease.

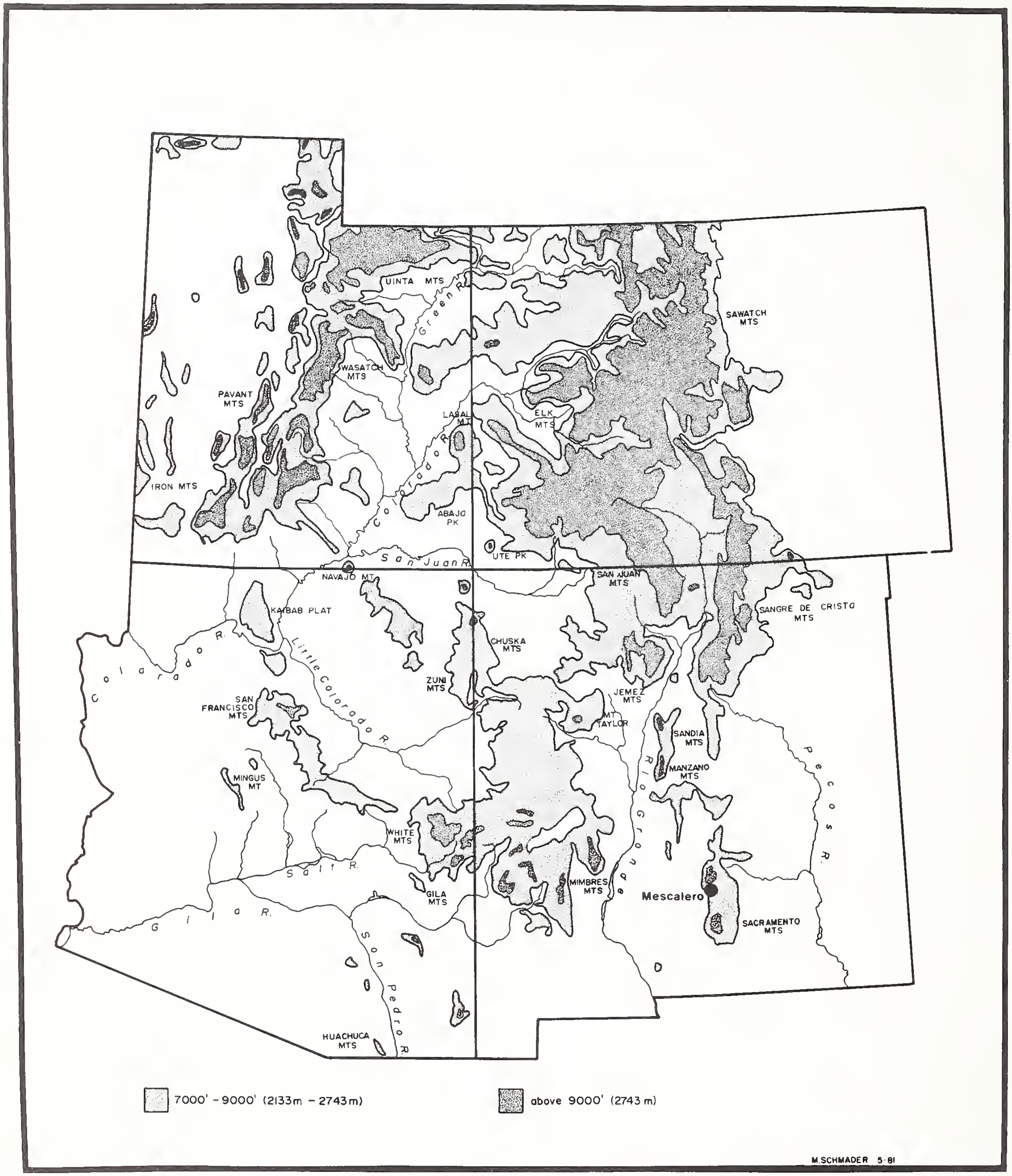


Figure 32. Mescalero Reservation High-Altitude Survey Area.

Proposition 3: As altitude increases, the specificity of seasonal use will increase.

If Proposition 1 is true it would be expected that there would be a decrease in the density of artifactual material per unit of surface space as altitude increases. In order to test this proposition the number of artifacts in each unit (a 20 meter diameter circle) must be counted. If Proposition 2 is true it would be expected that there would be a decrease in the total number of features requiring labor intensive behavior as altitude increases. A test of this proposition requires that kinds of features be counted within each 20 meter circle. If Proposition 3 is true it would be expected that assemblage complexity, the number of functional categories, will decrease as altitude increases. These three propositions constitute a model of the general trends which may occur in the archeological record.

Stage 2 involves the actual test of the three propositions through comparison of the archeological characteristics of each 20 meter circle as tabulated in Stage 1. The basic data manipulation in this stage involves the ranking of 20 meter circles by three controlling variables. First, they should be ranked by density from high to low, then by labor investment in features, and finally, by the number of functional categories. These rankings should then be checked against the elevation of the 20 meter circle to determine if each test can be validated.

Stage 3 examines the proposition that: "Archeologically, those populations experiencing the least subsistence limitations as altitude increases will also have the greatest uniformity in assemblage characteristics. A corollary proposition is that populations experiencing the greatest limitations will also experience the greatest stress in terms of specific site placement." Stuart proposed a series of specific characteristics which would be expected to occur in the archeological record for each of the three major prehistoric cultural periods: (1) PaleoIndian, (2) Archaic, and (3) Agricultural.

SAMPLE STRATEGY AND FIELD METHODS

The sample strategy and field methods for the Mescalero survey are summarized from the original program design written for the Forestry Archeological Program by Stuart (1978). As anticipated by Stuart, minor changes were made in some of the proposed sampling and recording procedures after our initial field survey at Acoma in the fall of 1978.

Sample Strategy

The sample unit utilized in this survey was the quarter-section, a square containing 160 acres (.6 km2) and measuring one-half mile (.8 km2) on a side. This allowed use of the existing land survey system as a grid for the sample and provided for precise identification and description of each sample unit. Because the commercial forest areas are often discontinuous irregular-shaped plots varying in size, the sample universe had to be defined in terms of the land survey grid system of sections and quarter-sections.

The sample universe was defined according to the quantity of commercial forest contained within each quarter-section. A quarter-section qualified for inclusion within the sample universe if it contained a minimum of 50 percent (80 acres or .3 km2) commercial forest vegetation according to vegetation type maps. Those units containing less than 50 percent were excluded from the sample. Through this technique a total of 1340 sample units was identified as eligible for inclusion in the sample universe. All lands, including grasslands and meadows were surveyed if they were contained in one of the sample units.

Sample strata were defined according to elevation and topographic variability. All sample units were ranked by their mean elevation into two independent strata based on traditional Southwestern Life Zones. The elevational ranges of these two life zones are: Transitional, 7000 to 8500 feet (2122-4590 meters) and Canadian, 8500 feet (2590 meters) and above. Although the mean elevation of several of the sample units was below 7000 feet (2133 meters), they were included in the Transition zone because they contained Transition zone vegetation communities. Within the Transitional and Canadian life zones the sample units were ranked according to their topographic variability as measured by a mean count of contour lines within each sample unit. A

proportionate stratified 10 percent random sample was selected from each strata of the 1340 unit universe yielding 135 sample units, totalling 21,600 acres (87km2).

Each sample unit was surveyed by field crews varying in size from three to seven people. The corners and boundaries of the sample unit were first located and flagged to allow clear visibility. Each unit was surveyed by crew members walking in a line spaced approximately 66 feet (22 meters) apart and making successive passes until the unit was entirely covered. Actual distance between crew members varied according to kind and density of vegetative cover and roughness of terrain. Upon discovery of any cultural material the crew stopped and gathered to record the material. In some areas pine duff cover, dense grass cover, or thick stands of scrub oak precluded thorough coverage of the ground surface. Extremely steep slopes were less intensively examined unless they contained slump boulder shelters, rock overhangs, or other topographic features where sites may occur.

The basic unit of observation of this survey was the artifact; the three analytical units were measures of variation in the density of artifacts. For the purposes of this survey an artifact was defined as any material altered or synthesized by man or any natural physical feature of the landscape which was altered or systematically moved by man. This definition included prehistoric as well as historic and contemporary materials. The three analytical units which measure artifact density were: isolated artifact, isolated occurrence, and site. An isolated artifact was a single artifact which is greater than 10 meter distant from a 20 meter diameter circle surrounding the next nearest artifact. An isolated occurrence consisted 2 to 24 artifacts within a 20 meter diameter circle, and a site was defined as 25 or more artifacts within a 20 meter diameter circle, or one or more features. A 20 meter diameter circle containing at least one feature, but fewer than 25 artifacts was also classified as a site. Isolated occurrences were recorded in the same manner as the archeological sites and eventually received Laboratory of Anthropology site numbers.

The Bureau of Indian Affairs policy with respect to archeological surveys on Indian lands was that no collection of artifacts were to be made. Due to this policy, detailed sets of artifactual data record forms were devised to systematically document artifacts and their attributes. The completed field forms were attached to each general site record form. The original version of the artifactual data forms are presented in Stuart's (1978) research proposal.

Cultural materials were systematically recorded according to the three analytical units described above, utilizing the specialized data record forms and general site forms. The location of artifacts, isolated occurrences, and sites were plotted on USGS quadrangle maps. Photographs of sites and isolated occurrences were made when the surface configuration or site features warranted photgraphic documentation. A site map was drawn for all sites and for isolated occurrences only when there were sufficient numbers of artifacts or features.

All artifacts were recorded for the categories of isolated artifact and isolated occurrence. Recording procedures for artifacts on sites were determined by the density and distribution of artifacts. If visual examination revealed clusters of artifacts, then proveniences were designated for those clusters. All artifacts were recorded on isolated occurrences and on sites if there were fewer than 100 artifacts on the site. If a site contained more than 100 artifacts, then all artifacts were recorded in a 1 meter circle in the center of each provenience. If no proveniences were apparent, a linear transect was laid out along the longest axis of the site and at each 10 meter interval along that line a 1 meter diameter circle was located in which all artifacts were recorded.

DATA ANALYSIS

A total of 45 prehistoric manifestations (18 sites and 27 isolated occurrences) was recorded on the Mescalero survey. Additionally, 100 prehistoric isolated artifacts were documented in the same area. Of the sites and occurrences, 39 were lithic scatters and only 6 contained both lithics and ceramics. Designation of cultural tradition and temporal placement drew on known regional traditions and chronologies. Cultural traditions include Archaic, 15

sites or 33.3 percent; Mogollon, 6 sites or 13.3 percent Archaic/Mogollon, 3 sites or 6.6 percent; and Unknown, 21 sites or 46.6 percent.

The distinctions in temporal affiliations of the archeological remains were based on ceramic selection of lithic source material, and upon projectile point type identification. Unfortunately, projectile point types can often be misleading in that sometimes older point types are curated by later groups. This appears to have been the case with the Folsom midsection which was located on a site which probably dated to the Archaic. Care should be taken in ascribing absolute temporal placement to sites based only on projectile point morphology.

The limited number and size of prehistoric sites was expected, given the original research perspective (Stuart 1978). Unfortunately, this situation makes it rather difficult to generalize about site function or settlement pattern. However, prehistoric occupations appear to have been limited, characterized by brief and usually single occupations by small groups for purpose of resource extractions (hunting, gathering, and quarrying of lithic materials).

The fragile and limited nature of the data also made comparisons between temporal periods somewhat sketchy. However, the development of density measurements for classes of functional items for all prehistoric sites has been quite useful and informative in evaluating the original research directions as outlined by Stuart (1978:27-28).

Stage 1 and 2

In regard to the three propositions mentioned under Stage 1 and 2 of the research strategies, the Mescalero data tend to support the first two propositions concerning the decrease of intensity and the duration of events of human use correlating with an increase in altitude. Site size and the total density of artifacts (ceramics and lithics) decrease, while definable features are absent from high-altitude situations (Tables 19 and 20).

There are only two exceptions to the decrease in artifact category density represented in the survey. Projectile points as a class show a slight increase in relation to an increase in elevation, and there is also a noticeable increase in the density of marginally retouched tools.

The density of projectile points and marginally retouched tools supports Proposition 3, regarding the decrease in number of tool types and complexity of assemblages. These items would be expected to be the last artifact types to decrease with increase in altitude. The marked increase in density of marginally retouched tools can be partially explained as they become replacements for more formalized tools such as unifacial and bifacial knives and scrapers. They are more energy efficient in terms of manufacture and are generally lighter in weight than more formalized tools. Also, the necessity of curation of these types of tools is not as great and there is not as great a loss if discarded after only one or two episodes of use.

The comparison of sites within the altitude zones as originally called for in the Stage 2 investigations was not possible due to the extreme lack of diagnostic tools and materials. The one observable pattern which was noted was a general lack of sites which could be classified as collecting stations versus hunting camps and activity areas. A divergence in site types, at least for the Archaic, was projected to be a possible development of high-altitude utilization. This was not encountered during the field investigation. However, the limited number of sites located may be a factor in obscuring this break in site types.

Stage 3

The specific characteristics of high-altitude utilization during the PaleoIndian period as proposed by Stuart (1978:32) was not possible to address due to the almost total lack of PaleoIndian materials at Mescalero. One Folsom projectile point preform and one possible Plano preform knife were the only truly early materials recorded within the survey area. Both of these items were found on later Archaic sites and are probably curated items. The question of PaleoIndian adaptations must await further work outside of the initial survey boundaries.

There is a very definable difference between Archaic and later Mogollon

Table 19. Mescalero Prehistoric Site Artifact Densities Per 2 Meter Circle

	Elevation			
	6500-6999 ft. (1981-2133m)	7000-7499 ft. (2133-2285m)	7500-7900 ft. (2285-2407m)	8000+ ft. (2438m+)
Total Sites	1	11	21	12
Projectile points	0	1.075	.830	1.715
Knives/bifaces	0	.940	.249	.181
Scrapers	0	.475	.344	.195
Non-utilized flakes	39	14.450	11.270	2.740
Utilized flakes	3	5.280	1.320	.909
Marginal retouch flakes	1	.599	.930	4.150
Total lithics	43	22.660	13.850	10.180
Total Ceramics	1	1	.142	1.090
Total Ceramics	1 (1 site)	12 (1 site)	2 (3 sites)	4 (3 sites)

Table 20. Average Site Size at Mescalero (m2)

	Elevation			
	6500-6999 ft. (1981-2133m)	7000-7499 ft. (2133-2285m)	7500-7999 ft. (2285-2467m)	8000+ ft. (2438m+)
Number Sites	1	11	21	12
Mean Size	150	11,028.72	6,248.85	1,116.91
Archaic	0	205	1.725	3,163.75
Mogollon	150	120,000	400	80
Mogollon/Archaic?	0	0	60,050	20
Unknown	0	21.50	10.76	122

assemblages. This difference is based on the location of identifiable projectile points on sites versus isolated artifacts. The majority of isolated projectile points, 10 in number, were identified as belonging to a terminal Archaic to late Mogollon date. Only six Archaic projectile points, ranging over a much broader time span, were recorded as isolated artifacts. This suggests rather different levels of utilization of the mountain region through time. Conversely, a total of 29 Archaic projectile points were encountered on sites and isolated occurrences as compared to only six dating from the terminal Archaic through the Mogollon period (Table 21).

In general, from this date, it would appear that the Archaic sites represent a more repeated seasonal use than the later Mogollon use of the same areas. The number of isolated Mogollon projectile points would support the proposition that the higher elevations were used for only short-term hunting expeditions by relatively small groups of people at this time. More substantial "base camps" associated with these activities are predicted to occur at lower elevations, which unfortunately are outside of the commercial forest boundaries.

Archaic "base camps" or "habitations" were located much closer to the actual area being hunted, demonstrating possibly either different hunting strategies or a decline in the availability and access to game animals from Archaic to Mogollon times. This situation may also represent a drop in emphasis upon hunting by the more agriculture oriented Mogollon populations.

Occupation of the high altitudes during the general Archaic seems to be greater in terms of labor investments and duration of stay at any particular site than for the later Mogollon stage. Although frequency of use of the land may have been substantial during the Jornada Mogollon, there appears to be a lack of long-term occupation and/or utilization of areas above 7000 feet (2133 meters) during this time period.

Another contrast noted between the Archaic and the Mogollon stages is in the selection of available lithic raw materials. During both time periods the local cherts were by far the most used lithic resource. However, there is a difference in that during the Mogollon stage a siltstone material first made its appearance within the lithic assemblages. We do not yet know if this material was selected because of some task specific need or if it was not known as a potential resource until the later Mogollon period.

The major contrast in attribute patterning through time is between the apparent emphasis on a "Biface technology," as indicated by the Archaic sites, compared with the more generalized lithic technology recorded on Mogollon sites. Bifaces made up 44 percent of all Archaic tools records, while only 34 percent were noticed on Mogollon sites. In contrast, expedient tools, or utilized debitage accounted for 43 percent of the Mogollon lithic assemblage, as compared to 39 percent of Archaic sites (Broster and Prince 1980:118-119). Further, the fact that retouch or preform preparation flakes occur only on Archaic sites strengthens the argument that Archaic sites derive from a very specialized biface industry associated with hunting activities of large game animals at higher altitudes. This is quite different from the more expedient low energy investment tool assemblage represented on Mogollon sites.

Although the survey data did not allow isolation of assemblages which violate the general trends, we would expect that the incidence of such cases would be very low. One known case outside the survey area which does violate the general trend is the site of Wizard's Roost which is located on a 10,363 foot (3151 meters) peak just northeast of Sierra Blanca Peak (Wimberly and Eidenbach 1977). This site contains three rock structures and three cairns and has been interpreted as a prehistoric astronomical observatory. The existence of such labor intensive features at such a high altitude is definitely a deviation from the trend established in the foregoing data analysis. Further, mountaintop shrines in the Southwest often contain numerous artifacts, also a deviation from established trends. Based on these observations, it would be reasonable to suggest that the propositions supported by the Mescalero survey data would only hold for subsistence oriented sites. Sacred or religious sites, or any non-subsistence oriented sites (quarries, workshops, etc.) might be expected to deviate from the trends entirely.

Table 21. Summary of Projectile Point Types from Sites and Isolated Artifact Locations Recorded on the Mescalero Sample Survey (the S and IO in parentheses indicate site or isolated occurrences)

		Archaic						Late Archaic to Early Mogollon Corner-Notched				
Site Number	Paleo-Indian	Jay	San Jose	Datil	Pelona	Augustin	San Pedro	Expanded Stem	Straight Stem	Unknown Stem	Mongollon Side-Notched	Totals
Points from Sites and Isolated Occurrences												
LA 20609(S)	-	-	-	-	-	-	2	-	-	1	-	3
LA 20610(S)	-	-	-	1	-	1?	-	-	-	-	-	2
LA 20619(IO)	-	-	-	-	1	-	-	-	-	-	-	1
LA 20621(IO)	-	-	-	-	-	-	1	-	-	-	-	1
LA 20636(IO)	-	-	-	-	-	-	1	-	-	-	-	1
LA 20645(IO)	-	-	-	-	-	-	1	-	-	-	-	1
LA 20658(IO)	-	-	-	-	-	-	-	1	-	-	-	1
LA 20663(S)	-	-	-	3	-	2	-	-	-	-	-	5
LA 20665(S)	-	-	-	-	-	-	2	-	-	-	-	2
LA 20666(S)	-	1	-	-	-	-	2	-	-	-	-	3
LA 20668(IO)	-	-	-	1	-	-	-	-	-	-	-	1
LA 20669(IO)	-	-	-	-	-	-	1	-	-	-	-	1
LA 20670(S)	1*	-	-	-	-	-	1	-	-	-	-	2
LA 20671(IO)	-	-	-	-	-	-	1	-	-	-	-	1
LA 20673(S)	-	-	-	-	-	-	-	1	-	-	-	1
LA 20685(S)	-	-	-	-	-	-	-	-	-	-	-	1
LA 20687(IO)	-	-	1	-	-	1	-	-	-	-	-	2
LA 20688(S)	-	-	-	-	-	-	5	2	-	-	-	7
Total												36
Sample Unit Points from Isolated Artifact Locations												
3	-	-	-	-	-	-	-	-	-	1	-	1
4	-	-	-	-	-	-	-	-	1	-	-	1
5	-	-	-	-	-	-	-	-	-	1	-	1
8	-	-	1	-	-	-	-	-	-	-	-	1
22	-	-	-	-	-	-	-	-	1	-	-	1
28	-	-	-	-	-	1	-	-	-	-	-	1
34	-	-	-	-	-	-	-	1	-	-	-	1
37	-	-	-	-	-	1	-	-	-	-	-	1
40	-	-	-	-	-	1	-	-	-	-	-	1
43	-	-	-	-	-	-	-	-	1	-	-	1
74	-	-	-	-	1	-	1	-	-	-	-	2
76	-	-	-	-	-	-	-	1	-	-	-	1
77	-	-	-	-	-	-	1	-	-	-	-	1
101	-	-	-	-	-	-	-	1	-	-	-	1
110	-	-	-	-	-	-	-	1	-	-	-	1
Total												16

*Curated item

SUMMARY

The high-altitude research strategies and trends presented in this paper are intended to apply only to prehistoric remains which are subsistence-oriented in function. Sites which functioned for religious or non-subsistence oriented purposes would be expected to deviate from the trends established by the Mescalero data. Application of these strategies and trends to historic period remains is not possible due to the high level of transportation technology in the historic period which provided greatly increased access to high-altitude resources.

Based on the Mescalero survey data the three propositions presented by Stuart (1978) are supported. However, due to the small sample size of 45 sites, these propositions should be tested on a larger data base at other high-altitude localities. Additionally, the examination of the specific characteristics of high-altitude utilization during the PaleoIndian period will have to be examined elsewhere. Toward these ends the Forestry Archeological Program will be collecting and analyzing prehistoric site data from other high-altitude localities on Indian lands in New Mexico.

PART SIX: CROSS-CULTURAL PERSPECTIVES

PUEBLO USE OF HIGH-ALTITUDE AREAS: EMPHASIS ON THE A:SHIWI

Edmund J. Ladd

INTRODUCTION

Before Francisco Vasques de Coronado arrived in 1540, ushering in the "historic period," the Pueblo region forming the northernmost extension of the Southwest culture area covered the Four Corners country which included portions of southern Colorado, Utah, and most of Arizona and New Mexico. The landscape throughout this region is extremely diverse. The people who occupied these lands also varied culturally as well as linguistically; all, however, depended on water (rain) for survival in this semiarid and arid land.

The following is a brief discussion of the life-ways of a living people, with special emphasis on the a:shiwi, the Zuni, who have their origins and their roots buried deep in the land. The socio-political religious background is given in the hope that it will shed some light on why Native Americans have such strong feelings for their land. Also, it provides a basis for interpreting Pueblo archeological remains at high altitudes.

As pointed out by Woodbury (1979a:26) a great deal of the culture of the Southwest was derived from the civilization of Meso-America; ceramics, agriculture, architecture, ceremonialism, religious beliefs, and rituals all trace their origins toward the South. Once they were received, the elements forming these components were modified and re-oriented for the local pattern and needs of the people which have persisted throughout pre-history and history to modern times as distinctively Puebloan patterns. The carriers of this Puebloan culture were Anasazi. The living Puebloan people who live in New Mexico and Arizona reflect these earlier patterns. Although it is agreed that specific archeological ruins, in most cases, cannot be directly tied to the living culture, the total patterns are recognizable from the ethnographic data. Outside of the Puebloan area where Indian cultures have been scattered and dislocated the implications are more tenuous (Ibid:27).

BACKGROUND

From the village of Taos in northern New Mexico to the Pueblo of Isleta on the Rio Grande south of Albuquerque, then westward to the mesa top villages of the Hopi in Northern Arizona, are found the towns of the Pueblo ("village dewelling") Indians. In this semiarid and arid landscape they have practiced agriculture, and developed distinctive arts and crafts and a comprehensive religious and ceremonial system. On the surface the Puebloan cultures are very similar, but they differ in detail. Traditionally, the major subsistence activity was agriculture - cultivation of corn, beans, and squash, whereas earlier, hunting was the emphasis of subsistence. Also, in this very dry environment there developed a great religious ceremonialism based on water (rain).

Missionary activities begun in 1540 by the Spanish had a great impact on the culture. However, actual colonization of the Rio Grande area in 1598 created other impacts which included the introduction of new domestic animals such as cattle, horses, sheep, and swine, as well as new additions to the agricultural crops. The social impacts - both religious and political - have had the most lasting effect, especially in the Rio Grande Pueblos where missionary activities were more intense. As a reaction to the colonization and missionization activities, the Pueblos under the leadership of Pope, a man from the Pueblo of San Juan, revolted in 1680 and expelled the Spanish from New Mexico. In 1692, Don Diego de Vargas retook all of New Mexico in a "bloodless" reconquest.

Afterwards, the Athapaskan speaking Navajo and Apache became mobile through the acquisition of the horse and began raiding not only their Pueblo neighbors but also the Spanish villages. In mutual defense, the Pueblos and Spanish banded together against the raiders (Eggan 1979:126).

There were continuing missionization activities during the 1820s with the tendency toward population mixture between Spanish and various Indian groups.

In the American period starting about 1848 (Eggan and Pandey 1979; Ladd 1979:493), the present settlement patterns were established. A shift from Spanish rule to Anglo law and order, and in some Pueblos an infusion and fusion of western religious concepts - mainly the Catholic Church - occurred. Also, whereas during the Spanish period the Pueblos and Spanish tried to control the semi-nomadic raiding of the Navajo and Apache, it was the U.S. Army that finally brought them under control in the 1860s (Eggan and Pandey 1979).

Upon first glance the modern Puebloan patterns appear to be a confusion of details. However, upon closer examination, they are overshadowed more by the complexity of organization and type rather than by content. This confusion and superficial complexity is caused by the various methods and types of religious, social, and political organizations and their individual activities (Ladd 1979).

Despite the language and individual differences in structure, there is a general similarity of types throughout the Pueblo region. Basically, there are four linguistic stocks: the Hopi speak a language of the Uto-Aztecan family; the Zuni are theoretically distantly related to the California Penutian; the Keresans, a Western and Eastern Branch, have no known linguistic affiliations; and the fourth (Tiwa - Tewa - Towa) are of the Kiowa-Tanoan family (Eggan 1979:226).

With regard to the social organization the situation is somewhat more complex. The social institutions of which there are several, cut across the linguistic divisions. The basic systems are the clans, the kinship systems, the kiva systems, and the medicine societies. The latter, however, are limited in distribution. The medicine or curing societies are well developed among the Keresans and the Tewa of the Tanoan family, with marginal importance among the Hopi. These societies are well developed and important among the Zuni where each curing society is responsible for certain ceremonial functions and the control of particular kinds of sickness.

Regardless of the organization - kiva, medicine, public or secret - all religious activities are concerned with rain, and the protection and welfare of the tribe and the individual or individuals performing the ceremony. Among the Zuni and Hopi, various societies perform specific ceremonies on a calendrical cycle. Some are public, such as the Soyal ceremonies at Hopi and the Shalako ceremonies at Zuni. The Eastern Rio Grande Pueblos, who were more directly influenced by the Spanish, have superimposed on their native rituals those of the various Catholic Saints Days.

The "Clown" societies in most Pueblos have a sacred nature. They, being ceremonial buffoons, give support to a variety of social controls through public exposure and ridicule of the nonconformist or of some infraction of social behavior. Among the Zuni there are two separate and distinct groups. The <u>koyamshi</u>, sometimes called the mudheads, are the silliest and the most dangerous of the gods. The <u>ne:we:que</u>, called the Galaxy society because their domain is the Milky Way, have two aspects: those of clowning and curing. Membership in the <u>ne:we:que</u> society is through trespass or being cured of an illness by the society.

The Pueblo people have and continue to have a deep reverence and respect for the land on which they live. They believe in conservation not in the sense of "saving" but in keeping it uncontaminated by showing a reverence and respect for the spiritual powers inherent in the land, a spiritual power vested in the land by the gods. In general, the uses of the land, although varying from tribe to tribe, reflect this basic principle as also reflected in the brief foregoing outline of religious structure and organization. The uses of the land, especially for subsistence such as hunting, gathering, and agriculture are directly tied to the religious sytem. It is interesting to note that there is not one activity among the <u>a:shiwi</u> that is done for what would be defined in Anglo terms as "only for fun," or recreational. There is for every effect on the land, whether by an individual or the group, a defined and prescribed procedure.

THE ZUNI - A:SHIWI

Except for a few who left home for one reason or another, nearly all of the other

7000 a:shiwi live on a 400,000 acre reservation in New Mexico (Figure 33). Their language is unique in that there are no other related Puebloan languages. They not only have their own language, they have their own religious system, aspects of which are unique.

The following is a description of Zuni now, in 1980. It is a description of an ongoing, functioning, viable culture with all three elements of culture intact (land, language, and religion) that assure it of having a long and healthy life.

The a:shiwi view their universe as a single complete whole. All parts are equally important. Metaphorically this includes "The four oceans, the moss covered mountains, the forests, the springs, the rivers, the lakes that surround the land." The total landscape is their religious universe. To put it another way: "The world is their church." The entire world is sacred, but certain portions and places are especially sacred. This concept and the relationship of the people to their environment permeates the religious life and use of the land. It is important to maintain an equilibrium with nature in all its parts.

This is the religious universe for which the a:shiwi have deep feelings of respect and reverence. This same respect and reverence they have for all life.

The religious use of the land is nondestructive. That is, little to nothing is removed or added. Where there is collecting for religious purposes, such as herbs, paints, and boughs, it is done with reverence and prayer offerings. Time, place, reverence, and proper attitude and performance are all important.

Based on a few archeological reports, there is, as might be suspected, little doubt that nearly every high mountain in the Southwest was at one time or another used for religious and other purposes by the Pueblo people. The general boundaries of the modern a:shiwi lands, from the point of religious and other uses, are the high mountains and geographical regions which are held in special reverence and are especially sacred to different classes of ceremonial and religious activities. These include the Sandia Mountains, the Jemez Mountains, Mount Taylor, Blue Mountain in southern Utah, the Grand Canyon, the San Francisco Peaks, and the Mogollon, White and Tularosa Mountains (see Figure 33). Within this geographical area are numerous springs, streams, ponds, caves, mesas, trails, and buttes that are of special religious significance.

Archeologically, shrines are identified as places of human use which sometimes have little or no modification of the surface. However, items of human activity, i.e., pottery sherds, turquoise, shell beads, feathers, worked stone, bone, and/or wood that were left as offerings often occur (see Parsons 1918 for Laguna and Zuni shrines). Historically, shrines are identified with specific ceremonial activities of specific individuals and societies. Identifiable shirines, i.e., those with some structural features or remains of offerings, are found in caves, and usually on summits of mesas and on mountain tops (Hough 1907:19). Parsons, for examples, records the following for the Pueblo of Laguna:

> All the cheani used to offer feather-sticks. Formerly after a four-day retreat they made an annual summer pilgrimage to Mount Taylor, the highest peak in the conspicuous mountain range twenty miles northwest of Laguna . . .
>
> Nowadays the pilgrimage is made only in time of drought. There is on Mount Taylor a big hole called shiwanna gacheti (lightening home). To it lead four well-marked trails, one from Laguna, one from Taos, Santa Clara, etc., one from Acoma, one from Zuni. Closure of the hole is the cause of drought, and so the cheani open it and offer feather sticks (Parsons 1918:184).

Springs often were, and are, places where offerings are given. If the spring is on a trail leading to a more specific shrine, as are the artifact deposits discussed by Hough (1907:19) at Gallo Springs in Western Socorro County in New Mexico and by Morris (1980) at Bead Springs on Escudilla Mountain, often they will be used as places for making offerings. The collections at the Gallo Spring Site could have been associated with a ceremonial called i/cu/ma:we during the Winter Solstice when symbolic objects are made for good things

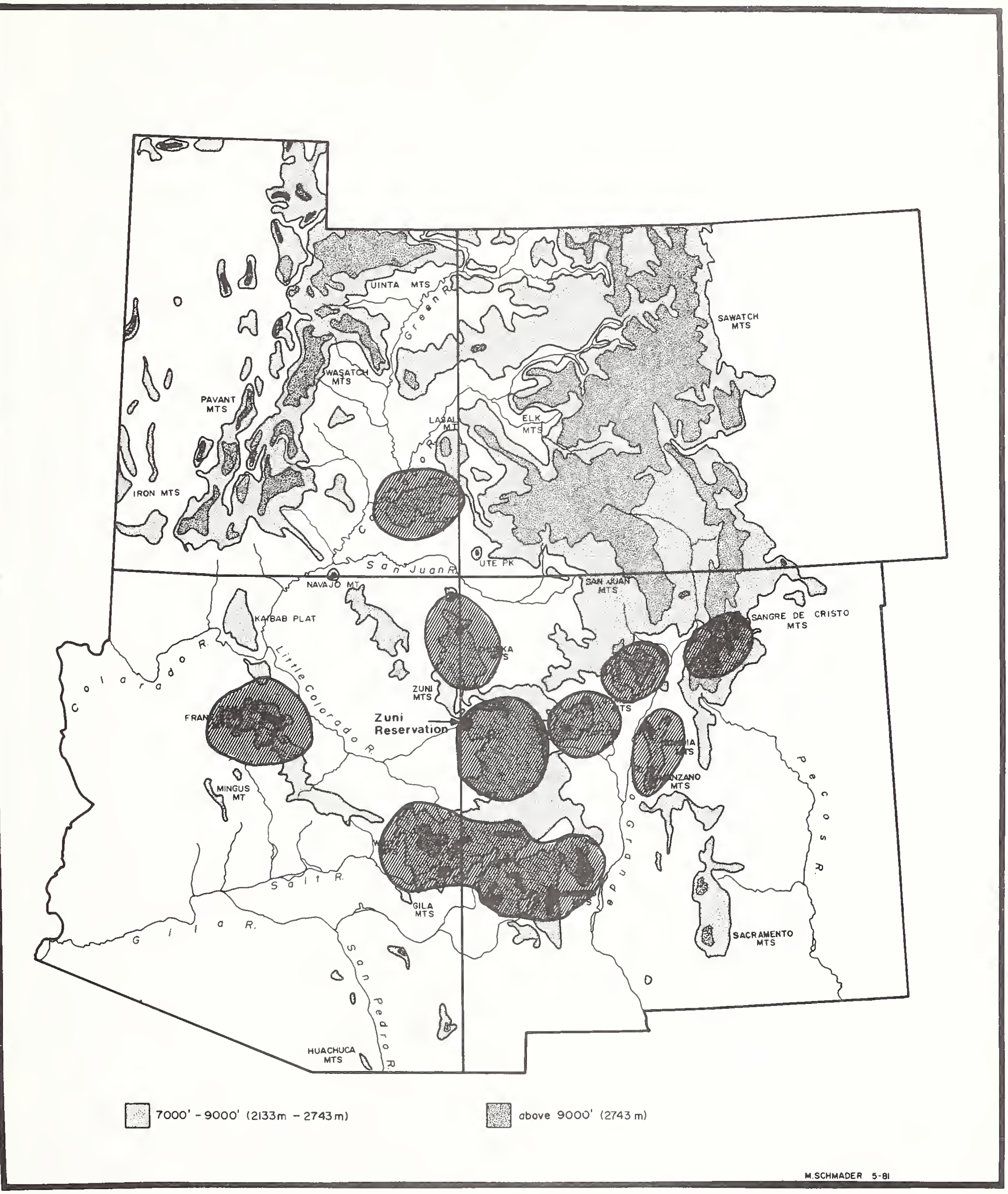


Figure 33. Location of the Zuni Reservation and Important High-Altitude Areas, shown by diagonal lines.

to happen. Everyone participates in this activity and in the preparation of the offerings. The offerings are given during the "middle time" (Tedlock 1979:502). The large number of people involved in the ceremony would account for the abundance of these miniature objects.

In addition to caves and springs that are unmodified and more or less natural, there are shrines that are constructed of stacked stones, stone rings, and monoliths, such as the "sun shrine," a single standing stone at the Pueblo of Zuni (Fewkes 1891:4-12), and the shrine on the ruins of mat/tsa:kya east of the Village of Zuni which are used to calculate the summer and winter solstice periods.

The basic offering made by even someone who is "poor," i.e., someone who has no religious position, is four prayersticks during the summer and winter solstice period. He or she, depending on their faith, make prayermeal offerings every morning. Offerings of food (at every meal), tobacco (ceremonial smoking), prayermeal (coarse ground white corn with crushed sea shells and turquoise), and prayersticks (to the ancestors and to the dance gods) are the most valuable gifts to the gods (Bunzel 1932:498-499). These are the "common" types of offerings. Special forms of prayersticks with appended "cloud-shields," turquoise or shell beads, and miniature bows, are made by specific religious leaders and societies (Parsons 1918:381-405) and are deposited on special shrines belonging exclusively to that society.

In 1980, J. W. Fewkes visited 21 shrines in and around Zuni; he made the following observation of some shrines:

> The most elaborate shrines which were visited are two on top of the mesa, said to be the gods of war, Ah-ai-u-ta and Ma-at-se-we...These shrines are more elaborate than the others already mentioned, and the war god is represented by a stake or log on which is a rudely carved face. Around it were strewn many other similar stakes carved in the same way, which had evidently once stood in its place. The upright log had tied to it a string to which were appended feather offerings, strings of shell beads, and the offering represented in the cut, which is said to have been placed there by the Priests of the Bow. The last mentioned offering consisted of a shield made of a hoop over which is strung a network made of cotton string, a small bow and arrow fastened across the shield, sea-shells and a wooden stick to which are tied prayerplumes.
>
> Many offerings of shell beads are found scattered about on the more elaborate shrines on the top of the mesa. One rarely sees these expensive offerings on the shrines in the valley, or in those of the caves at the foot of the mountain, but as a rule the offerings naturally are less costly on the simpler shrines (Fewkes 1891:10-11).

The common offerings can be made by anyone at anytime. Hunters, the night before starting on their quest, perform certain rituals in the house of the hunting society (Kirk 1950:131-141). Each hunter must prepare his own prayersticks that are carefully carried to the hunting grounds. Once the hunting area is reached, early the next morning, each hunter "plants" his prayersticks and offers the prayermeal with the appropriate prayer. When the hunter kills his game, after first "purifying and uttering" a short prayer, he prepares the ground where the entrails will be dropped. Once again prayermeal is offered and the animal is skinned. When the animal is brought into the home additional prayers are offered (Mahooty 1980:28-33). Anyone who has a mind to can give prayermeal and prayers at any spring, mountain top, ruins, trail, anthill, tree or bush for thanks or in supplication for a good day, long life, welfare of the people, and so on.

In previous times, before fast transportation was available, men from the Pueblo traveled on foot, or by horse, mule, or donkey to the various hunting areas. Prehistorically they walked. They generally camped for several days and even up to a month (Edaaki 1980) as they dried the meat and dressed the hides for tanning. The hooves were carefully cleaned and brought home to be used in ceremonial dance costumes. Before all the Fish and Game Laws, hunting for a variety of animals and birds was done anytime of the year (Mahooty 1980).

SOCIO-RELIGIOUS STRUCTURE

To try and discuss in these few pages the total religious system of the a:shiwi would not be realistic - especially since many volumes have been written and are available for reference. The following is intended to shed some light on the interrelationships of the structures and the functional units, and to discuss in a brief overview the ceremonial cycle to reflect the frequency of uses of certain religious shrines and geographical regions.

The religion of the a:shiwi involves everyone. The social, religious, and political system with its strong interconnections to the ceremonial and religious cycles and to the kin and clan system is a very complex structure. To get some understanding of the total system one must visualize four separate interlocking wheels each operating independently and moving synchronically to form a whole. The whole is held together by the annual ceremonial cycle based on a lunar pattern of twelve months.

The religious system is composed of four major interlocking subsystems superimposed one upon the other. The first is the 14 matrilineal, totemically named exogamous clans (not counting the nine subclans). The second is composed of the kiva groups, sometimes called the Kachina Societies; they are the men's organization of which there are six. The medicine or curing societies called by some of the Beast Gods, of which there are ten, with two extinct since about 1960, form the third. The fourth unit is composed of the Priesthoods of the Rain, of which there are 16, and the Priesthood of the Bow, sometimes called the Cult of the Gods of War in which membership is limited to males who have taken an enemy scalp. In 1980 there are six Bow Priests. The number of Bow Priests vary. Vacant since the 1940s is the position of pequenne, or the Priest of the Zenith, sometimes called the Sun Priest.

Clans

Membership in a clan is by birth. When a child is born, its position is established within the kin-clan group. What it is called, how it calls others, and who it cannot or can marry are established. Positions at birth determine future behavior and how others will behave towards the child. It belongs to the mother and the mother's household, where its greatest responsibilities and loyalties will lie. It belongs to its mother's clan. This immediately establishes future behavior patterns and also determines what position of responsibility it will hold in the religious system. It is a "child" of its father's clan, a relationship that determines future behavior and responsibilities toward members of its father's household and father's clan. Father's clan members and household will provide support in all aspects of religious and life crises for the child.

Kiva

The six Kiva groups or the dance societies are men's organizations. All male tribal members at age eight to twelve undergo their final initiation into one of the six groups. The choice of which group to join is determined at birth, but can in future years be changed by the individual. These are the groups that are responsiblbe for the ceremonial cycle. Each group in turn performs various ceremonies during the year, both public and secret, for the spiritual well-being of the tribe.

Curing Societies

Membership in any of the 12 curing societies is open to women and men. There are several ways that one can become a member. One way is to be "saved" or "cured" from an illness by the society. A person that is determined to be so sick as to be beyond conventional help is "given" to the society whereupon if they become well, they are obligated to become a child to the society and are eventually initiated into the society. Also, there are certain times when the ceremonial house of the society is taboo, that is, non-members may not step on or over the threshhold. Anyone who breaks this taboo is immediately initiated. In addition, all initiated members at certain times are taboo. Anyone touching in any way the "private parts" of a member under taboo becomes a "child" to that member and is initiated into the society.

Priesthood

The Priesthoods are highly specialized. The first unit is composed of 16 Rain Priests - The a:shiwann/i - which are divided into six Daylight Priests and ten

Night Priests. Membership includes women and men and is clan affiliated and appointive. The Priesthood of the Bow, the a:pilha:shiwann/i, called by some the cult of the War Gods, is limited to male members who have taken an enemy scalp. They are the "mouth piece" speakers for the Rain Priests; they enforce various infractions of religious laws and otherwise speak on behalf of the religious leaders in public matters.

Given these general outlines of the religious structure, membership within the system can thus be charted (Figure 34). At a minimum level, every tribal member belongs to a clan for which there are minimal religious obligations. Although not mandatory, a man's minimum level of involvement includes membership in one of the six men's societies.

CEREMONIAL CALENDAR

Between these independent units and their special functions is the binding element of the calendrical observances. Each of the independent units are responsible for certain ceremonies on an annual and monthly schedule throughout the year.

The ceremonial year is divided into summer and winter, each with 6 months. Each month is divided into three parts, each with 10 days. Although the ceremonial events are based on a lunar count, the major division between the summer and winter solstices are determined on solar observations. The summer solstice ceremonies occur in mid-June or early July and the winter solstice occurs in late November or mid-December, depending on the dates set by the Chief Priest.

During the summer solstice period shrines located to the east on Mount Taylor, the Sandia Mountains, and the Jemez Mountains; to the west on the San Francisco Peaks, and Woodruff Butte; to the north on Blue Mountain in Utah; and to the south on Mount Baldy, Eagle Peak, and Greens Peak, are visited by various orders of religious leaders in connection with supplication for rain, good crops, collecting of medicinal herbs, and spiritual protection. On the flanks of these same peaks at springs and along trails are special places where ceremonies of various kinds are conducted during the winter solstice period. The ice caves, between Grants and Ramah, are especially significant during the winter solstice period.

In addition to the regular cycle visits during the winter and summer solstice periods, peaks like Eagle, Green, Hardcastle, Beaver, Sandia, and the Jemez Mountains are visited during certain portions of the initiation rites associated with the curing societies. Also, during early spring and summer, anyone who "has a good heart" may visit these places and make personal offering or collect medicinal herbs, after "making payment to the gods."

The Kiva members who are responsible for the masked dances and major ceremonies during the summer and winter solstices make monthly prayerstick, prayermeal, and prayer offerings at various springs in the mountains. The curing societies also make monthly offerings at springs and mountain areas at which time they also collect medicinal herbs.

The winter solstice period is the "middle" time. That is, it is the end of a year long religious observance for some and the start of the year for those newly appointed. It is the New Year. It is a period for cleansing from the past and purification for the coming year. This is a period of time when rituals and ceremonies are observed by every segment of the society; every man, woman, and child participates in some aspect of religious observance. There are a total of 20 days set aside for the winter solstice ceremonies (called the sha/lak/o). All events are organized, arranged, and synchronized in such a manner that none of the ceremonies are in conflict.

This is also the period when the Deer and Bear Clans create the Twin War Gods. The Bow Priests take them to their shrines and depending on the sequence, the younger brother goes to the Blackrock shrine and the older brother goes to its shrine on Corn Mountain. This is done annually at each of several shrines which are rotated. During this period the war gods are "instructed" to give protection to the a:shiwi and to the world from all natural dangers such as cyclones, hurricanes, lightning, and dust storms. The unscheduled creation of the Twin War Gods is during the initiations of a Bow Priest connected with warfare at which time the images are taken to the different shrines.

Unit	Membership By Birth		Optional Membership	
	♀	♂	♀	♂
Clan	X (1)	X (1)		
Kiva				X (2)
Curing			X (3)	X (3)
Rain			X (4)	X (4)
Bow				X (5)

(1) Everyone is born into a clan. They are a member of their mother's clan and they are a child of their father's clan.

(2) Most males at the age of eight to twelve join one of the six men's societies. Women are not excluded but are discouraged due to severe physical demands.

(3) Membership is through trespass and curing from illness.

(4) Membership is clan affiliated and appointive.

(5) Membership is limited to men who have taken an enemy scalp.

Figure 34. Tribal Membership in the Socio-Religious System.

In times past, the high mountains in all directions were places where the Bow Priests enshrined the war gods as a protection of the a:shiwi against raiding enemies such as the Navajo and Apache. As the land base shrank and the pressures of the Navajo and Apache were further aggravated by the melika (the white man), the shrines were "pulled in" closer to the valley where they are now found.

In addition to the monthly offerings made by the Kiva and Curing societies, this is also the period of time when the heads of all religious organizations "make their payment" (offer prayersticks, prayermeal, and prayers) to the gods at various springs and mountain regions.

DISCUSSION

The cultural patterns shared by the Puebloan people of the Southwest are rooted deeply in the land. Ethnological and archeological data shown that the natural resources of the area defined by archeologists as the Anasazi Culture area have been utilized from the times of the PaleoIndian hunters, right through to present day Pueblo farmers and ranchers. The archeological information for the early developmental stages are presently less understood - due perhaps to the low population density and the paucity of early archeological remains - than the sedentary periods beginning about A.D. 700. The Puebloan land use and subsistence patterns, using specifically Zuni data, are here summarized.

Prehistory

Geographically, the Zuni occupy a region that is peripheral to two major archeological regions: the Western Anasazi (Plog 1979:108-130) to the north and east, and the Mogollon to the south and west (Martin 1979:61-74), with the strongest influences coming from the Chaco Canyon Center of the Western Anasazi to the northeast with later influences coming from the Upper Gila area (Woodbury 1979b:468).

There is no doubt that the Zuni people occupied the now ruined village of Hawikuh up to circa 1680 and the present village from about 1692. They had been living at Hawikuh for some 250 years prior to contact with the Spanish in 1540. Before A.D. 1300 there appears to have been a relatively unbroken development starting at about A.D. 700 to 800 or late Basketmaker III times.

In an environment that was probably not much different than today, the precontact Zuni employed the usual basic three food procurement strategies: gathering, agriculture, and hunting, each of which required a different land use strategy. Emphasis on which strategy to use depended on the season and elevation. Hunting, a male activity, and gathering, a female activity, required little to no social controls. Agriculture, on the other hand, required a special kind of control. The actual planting and tending was predominantly a male activity. The harvest, once brought into the home, was the woman's responsibility. The land was controlled by the clan, basically the household, that had "use rights" to certain areas.

The socio-religious structure of the Zuni as reflected in the Kiva, which is the architectural feature identified as the ceremonial structure of the men's religious organization, appeared early in the Development period. In addition, special places of apparent religious significance and high elevation useage have been recorded by Morris (1980), Hough (1907), Wilson (1979), and Wendorf and Miller (1959). These have been identified as shrines and hunting campsites.

History - 1980

The ancestral Zuni, especially from the Mogollon branch, began using the high mountain peaks in the Upper Gila and Salt River areas perhaps as early as A.D. 1000 and certainly through A.D. 1300. Hunting large game, plant gathering, collecting inorganic substances, and religious activities were, and are, the main uses of the high elevation regions of the Zuni country. Although rituals in connection with hunting are still observed, hunting is no longer a serious subsistence activity. Collecting of plants and paints are still very important. Ritual activities in connection with shrines are most important in Zuni Culture.

The Zuni, and the Pueblos in general, look upon their land as sacred and the world is their church. All of the land including the mountains, mesas, springs, valleys, and forests are the homes of the spirit beings that represent themselves to humans in

medicinal plants, deer, elk, bear, badger, mountain lion, and other animals and plants. Any disruption of their homes is thought "not good." The disturbance of the land by the construction of dams, roads, pipelines, and other land surface destruction activities, especially in close proximity to shrines, destroys this balance.

The term shrine is used here in its broadest sense, i.e., not only a single site, such as the war god shrine at Blackrock on the Zuni reservation, but also a region such as Mount Taylor, San Francisco Peaks, and Mount Baldy.

The following list of place names was collected in Zuni depositions during the research for the Zuni Land Claims Case, in Zuni, New Mexico in February 1980. A total of 194 place names was recognized. Only the most significant areas for the summer and winter ceremonies involving high elevations, trails, buttes, springs, and other natural areas are here listed. A complete list, as taken from the depositions, is appended for reference (Table 22).

shipa:pulima - This is a place used by the a:shiwi and the Rio Grande Pueblos near Redondo Peak in the Jemez Mountains. The curing societies gain their power and strength from this shrine. It is the origin place for some of the curing societies and until about 1890 or the early 1900's it was visited annually by the shi:wana:que curing society. Members of the a:pilha:shiwanni, the Bow Priest, the /anshe:que (Bear) clan, the Galaxy curing society (the na:we:que), and the Kachina Chief (Ko/moss-ona) made a pilgrimage to the shrine in the spring of 1980. This is identified as the Stone Lions in Bandelier National Monument on the Pajarito Plateau in the Jemez Mountains.

chi:piyayall/a - This is a shrine and origin place of the shuma:que curing society. The shrine is used exclusively by the a:shiwi. Although the whole mountain is named the exact location of the shrine is in the center of the ridge forming the Sandia Crest east of Albuquerque. The shrine is a small cave south of the present ski lodge and TV transmitter station. This society is not very active now, but both the sa/yapa:que and the shuma:que members visit the site annually during the early spring.

lhem/ula - The ice caves between Grants and Ramah, New Mexico, this is a specific shrine of the "Long Horn," i.e., the chief of the council of the gods during the winter solstices. The impersonator of the Long Horn, who is selected for a year long position, visits the ice caves at least twice during his period of service. It is used during both the winter and summer solstices, but it is especially significant during the winter ceremonies.

qiliyallan/e - These are the twin buttes northwest of Zuni Village. This is one of the shrines where the war god images are placed during the initiations of a Bow Priest. The visitation is sporadic. It is also the place where the a:shiwi took refuge during the great flood.

jan/lhipinnka - This is a small canyon west of the village near present day Witch Wells Ranch in Arizona. It is the origin place of the /annoti:we, the clans. On the canyon walls are thousands of petroglyphs depicting the clan symbols. Anyone can visit here anytime to make offerings at the head of the canyon where there are a number of small ponds and natural water tanks in which rain and melting snow water collects.

ko lhu/wala:wa - Literally the village of the dance gods. This is at the junction of the Little Colorado and the Zuni River near the town of St. Johns, Arizona. This is the most sacred place to all the a:shiwi. It is the home of the ancestors. It is the place where the spirit returns upon death. It is visited every four years by the Kiva society each taking their turn. Mesas and buttes around the marsh ponds are highly significant to the religious beliefs. Along the trail are numerous places of significance. The Zuni River connects the living village with the village of the dance gods. The overland trail is marked with important religious places visited every four years.

tenatsal/emm/a - Place of the medicine flower tenatsali. This is Woodruff Butte, southeast of Holbrook, Arizona. Only the curing societies can touch or pick this medicine. It is highly potent and is handled only with utmost reverence and specific rituals known only to the curing societies.

sunha:k/apa:chuyallan/e - Literally the mountains toward the sunset. These are the

Table 22. List of Place Names Mentioned in Zuni Depositions Arranged in Order of First Reference

Key to Linguistic Symbols

/ - glottal stop
: - indicates length
la - lateral frictative
\- - suffix division

Spelling of place names standardized by Edmund J. Ladd, 03/04/80.

02/19/80 - Alonzo Hustito

	Place Name	Location
1.	shipa:pulima	Bandelier National Monument, Stone Lions.
2.	chi:piyayall/a	Sandia Mountains, east of Albuquerque.
3.	lhem/ula	Ice Caves, Valencia County, New Mexico, between Grants and Ramah, New Mexico.
4.	nalhuwala:wa	East end of Zuni Mountains, near Grants and San Rafael.
5.	towayallan/e	Mesa, east of Zuni Village.
6.	quiliyallan/e	Twin peaks, northwest of Zuni Village.
7.	lhak/alhonatah-na	North of Village, about nine kilometers.
8.	lhaulhetah-na	Vanderwagon area, north of Village, 13 kilometers.
9.	Black Rock	Six kilometers east of Village.
10.	hanlhipinka	Nine kilometers west of Witch Wells, Arizona.
11.	Kolhu/wala:wa	Sacred Lakes near confluence of Zuni and Little Colorado Rivers in Arizona.
11a.	ko:k/oshia:wan/yalla	Subarea of #11.
11b.	koyemshia:wan/yalla	Hill for mudheads at #11.
12.	peyak/oshi/a	Three kilometers from Highway 666, 19 kilometers north of St. Johns, Arizona.
13.	Ojo Caliente	25 kilometers southwest of Zuni.

14.	to:k/a-na/a	Small hill south of #13 - a spring.
15.	ma/k/a-ya	Zuni Salt Lake, Catron County, New Mexico.
16.	ahayadan/yallan/e	Two hills, south of Salt Lake.

<u>02/20/80 - Chester Mahooty</u>

17.	chimik/ankyate/a	"Place of Beginning" at Ribbon Falls in Grand Canyon, Arizona.
18.	tenatsal/emm/a	Woodruff Butte, southeast of Holbrook, Arizona.
19.	tapiliyanku	Six kilometers east of #18.
20.	heshotapitsuliya	Chaco Canyon, McKinley County New Mexico.
21.	Canyon de Chelly	Arizona.
22.	Mesa Verde	Colorado.
23.	sunha:k/apa:chuyallan/e	San Francisco Peaks, Arizona.
24.	tewanque:k/apa:chuyallan/e	Mount Taylor, New Mexico.
25.	K/ak/alianyallan/e	Eagle Peak, New Mexico, in Tularosa Mountains. Reserve area, Gila National Forest, New Mexico.
26.	sa:to:yallan/e	Hardcastle Peak, 80 kilometers south of Zuni, near Luna and Apache Creek, Apache National Forest, New Mexico.
27.	piliayalla:we	Willow Peaks, 112 kilometers east of #26.
28.	tona:yalla:we	Turkey or Guadalupe Mountains.
29.	/ulalhlhemina:yalla:we	"Land of Perpetual Snow," Fort Apache Indian Reservation, Mount Baldy.
30.	teshukt/enna:wa	Near El Morro Airport.
31.	he:mushina/yalla:we	Jemez Mountains northwest of Santa Fe, New Mexico.
32.	tu:shi/ank/a-na	Near Dulce, New Mexico, on Apache lands, Horselake.
33.	wilatsu:qenaque	General area of Northern Apache.
34.	ku/k/ohan:a	South of Navajo, Arizona, near Sanders.
35.	paiya	South of Zuni Village.

35a.	noponnitah-na	Subarea of #35.
35b.	K/a:techi/kowa	Subarea of #35.
36.	/uteya:yallan/e	Bandera Crater at Ice Caves between Grants and Ramah, New Mexico.
37.	wimanpowayallan/e	North and east of El Morro National Monument, a large hill.
38.	aqualhenna:yalla:we	Zuni Mountains. "Malachite Mountains."
39.	heshota:yalht/a	"Ruins on top of the hill" at El Morro; also name for Pool there.
40.	a/tsinn/a	El Morro, Inscription Rock.
41.	tsuyalla/a	Cerrillos Turquoise Mines, south of Santa Fe, New Mexico.
42.	lhiaquak/a:que/na	"Spring of Turquoise" on Fort Apache Reservation near #29.
43.	pi/k/ya/a	Spring at San Rafael, New Mexico.
44.	K/a:tulh/ullap/na	"Surrounding Waters" or Oceans - from where sun rises to where sun sets.
45.	sho/k/onanem/a	Quemado, New Mexico (see also #59 and #85).
46.	k/atsi/k/yanna/a	Lyman Lake, Arizona.
47.	tamaya	On Rio Grande between Bernalillo and Santa Fe, New Mexico, Santa Anna Village.
48.	k/a:k/alhna/k/ya:qayin/a	"Hot Springs" in Jemez Mountains, #31.
49.	Seama	Near Laguna Pueblo; general area has same Zuni name as #36 but is a different location or place.
50.	polan/aquen/que/na	"Canyon of Cottonwood" near Keams Canyon, Arizona.
51.	ha:memelea/yo:wa	Near Petrified Forest National Park, Arizona.
52.	cumanchan/alaque/a	Ancestral ruin near Two Guns, Arizona.
53.	lu:k/yan/a	Spring near #14.
54.	/uhann/a	On old Paiya Road, eight kilometers south of Zuni Pueblo.
55.	a/lhapatsi/a	Parallel to Paiya Road, four kilometers south of Zuni Pueblo.

56.	wi/k/al-/a	Four kilometers northwest of Zuni, near Bluebird Hill.
57.	yalla/lhan-na	"Big Mountain," six kilometers northwest from Zuni Pueblo.
58.	kyakim/a	South end of #15, eight kilometers southeast of Pueblo.

<u>02/21/80 - Theodore Edaakie</u>

59.	sho/k/ona:yalla/ne	Near Salt Lake, New Mexico (see also #45, #85).

<u>02/21/80 - Tom Awelegte</u>

60.	sha/lak/ona:wa	Six or eight kilometers west of Ojo Caliente towards St. Johns, Arizona.
61.	k/apequan/a	Nine kilometers from Ojo Caliente.
62.	ts/oklhikna:wa	Sixteen kilometers from St. Johns, Arizona.
63.	k/a:tulhlhann/a	Three or four kilometers from #11 heading east.
64.	he/epat/chi:wa	Nineteen or 22 kilometers from St. Johns on east side of Highway 666 near Lava Bluffs.
65.	k/a:wan/ahonn/a	"Red Water" area of St. Johns, Arizona.
66.	/itiwak/aynn/a or k/ana:palhta/a	Eight kilometers west of Ojo Caliente.
67.	kolo:wisank/aqua	Spring three kilometers southwest of Ojo Caliente.
68.	k/a:tsi:k/an/a	Spring close to #14, near Ojo Caliente.
69.	po/sho/wa	Eight kilometers east of Ojo Caliente.
70.	shoyak/osiqu/a	Near Calavaza sheep camp and Frank Montano ranch to the south of Zuni Pueblo, 14 or 16 kilometers.
71.	/ishanan/tek/appowa	"Grease Hill" one kilometer south of Zuni Pueblo.
72.	matsa:kya	One kilometer south of bridge between Zuni and Blackrock.
73.	/itiwatah-na	Midpoint in mountains. Six kilometers south of Zuni Pueblo.

74.	/aqualhann/a	"Large Canyon" nine kilometers southwest of Zuni Pueblo.
74a.	shu/tek/y-a	Place in area #74.
75.	/amosse/a	Twenty-two kilometers northwest of Village, Bosson Wash.
76.	ma/ettude	Near Manuelito Canyon, New Mexico.
77.	tonashiank/yann/a	Badger Springs, New Mexico.
78.	/oh/emm/a	"Place where the brain of a sheep stays."
79.	mo:chiquana:wa	First Hopi Village on the trail, "Place of Peaches," /awatu/a; Keams Canyon.
80.	polan/aquennquan/a	Cottonwood Wash near Ganado, #3 (not the place as #50, it is closer to Ganado than Keams Canyon).
81.	pipalhiyall/a	Red Rock area near Mexican Village of /atel/ahonn/a north of Zuni Salt Lake.
82.	shoto:k/a:wan/ahonn/a	"Red shell streams," 16 or 19 kilometers beyond St. Johns, Arizona, toward San Francisco Peaks.
83.	/itiwann/e	"Center Place" Zuni Pueblo.
84.	yallank/ohann/a	"White Mountain" south of Showlow, Arizona.

<u>02/22/80 - Frank Vacit</u>

85.	sho/k/onanem/a	Mountains east of Springerville, Arizona #3 (see also #45, #59).
86.	chishe:/al/aqu/a	Apache Creek, New Mexico.
87.	/atelak/ohonn/a	"White Rock" 19 kilometers east of Ojo Caliente.
88.	/amequelleyawa	Manuelito, New Mexico.
89.	shoyak/apa/a	Three kilometers southwest of Ganado, Arizona.
90.	War God Shrine	Nineteen kilometers south of Gallup, New Mexico, at small peak on west side of road.
91.	k/a:lhianak/a:qayin/a	Blue Springs, near Highway 666, northwest of Milan, New Mexico.

02/23/80 - Alvin Nastacio

92.	kiwaikuluk/a	Place in Jemez Mountains.
93.	tah-nak-ohann/a	San Felipe.
94.	tsiya/a:wa	Between Zia and Santa Ana Pueblos.
95.	k/aweh/ka	Village of Old Laguna.
96.	sh:k/a/aya	Top portion of Mount Taylor #24.
97.	kashi:kuk/a:tu	Another name for area #14, area bounded by roads from San Rafael to Ice Caves to High Mountains.
98.	/asu/wa	Pierced rock, six kilometers east of Blackrock Lake.
99.	/uk/yahayan/ell/a	"Feather Rock," six kilometers east of Blackrock Lake.
100.	ta/witapak/iwa	Four kilometers east of Blackrock Lake.
101.	/iyanik/a:waisha	After #92 in sequence.
102.	yash:tik/u:tu	Location in sequence coming from #92 toward Zuni on Zuni side of #101.
103.	mi/ashu:k/awa/ka	Toward east of #1, along Rio Grande River between Santa Clara and Cochiti Pueblos.
104.	heshe/aleto:wa	Lava flow east of Grants, New Mexico.
105.	tewanqu/onanpane:na	Prominent point overlooking Zuni at northwest end of airport at Blackrock.
106.	k/a:tski/yann/a	North end of #5.
107.	/ame:tola:tepo/u/a	East end of #5, near and including area of the peach orchards.
108.	te/po/quinemm/a	Two kilometers east of Zuni Pueblo, south of river, four kilometers west of #106.
109.	sho/tek/appowa	Hills south of river, north of #108.
110.	hepa:tenn/a	Near #72 on west side.
111.	tannenk/ya	First place after emergence from #17.
112.	yamunk/ya	Second place after emergence from #17.

113.	tsik/onk/ya	Third place after emergence from #17.
114.	/awesho:kya or /awesho:peta/awk/a	Fourth place after emergence from #17.
115.	cumanchan/alaque/a	In a canyon at Twin Arrows, Arizona, east of Flagstaff, Arizona (same as #52, different location).
116.	pittsemeteyachi:wa	"Place of Cottonfields" near the Hopi Village of Second Mesa.
117.	Moqqiteyachi:wa	"Onion Fields" or Hopi Village of Hotevilla.
118.	kane:luyallawe	"Sheep Mountains," between Shiprock and Bloomfield, New Mexico.
119.	teshu/tena:wa	Three peaks to the south of Ramah.
120.	teshu/lhan-emm/a	Largest of peaks to south and east of Ramah, New Mexico.
121.	k/nana:wa	Blackrock Lake, where Salt Mother originally lived.
122.	ha/k/winn/adeyalht/a	South of #5, along the same canyon as #74.
123.	ton/a:teanna:wa	"Place of the Turkey Tracks," eight kilometers south of Zuni Pueblo.
124.	teshamik/emm/a	Six kilometers south of Village.
125.	ma/pane:kyateya	Thirty-two kilometers south of Zuni on Old Wagon Road to Zuni Salt Lake.
125a.	pipalh/a	Same place, different name for #125, (see also #81).
126.	temossetah-na	Mountain Face near Crocketts Bar, 40 kilometers southeast of Zuni.
127.	Kyama:kya	Near Atarque, New Mexico.
128.	ha/pana:/alaqu/a	"Canyon of the Dead" northeast of Ramah, New Mexico at Vogt Ranch.
129.	natateque:wa	Near Nutria, "Deer Corrals."
130.	telhe/aque/a	"Canyon of Ritual Traps for Deer" between Pescado and Jacks Lake.
131.	pilan/aque/a	"Willow Wash" southwest of Zuni, southwest of Paiya to Ojo Caliente.
132.	Tek/apo	Twelve kilometers west of Zuni-Hill Ranch.

02/24/80 - Ralph Quam

133.	k/awanalhann/a	"Big Water" to the north - Rio Grande River.
134.	tsilhinn/yalh/a	River crossing at #133.
135.	top/oliya:k/a-na	Blue Lake, Taos Indian Reservation.
136.	/anshek/a-na	Bear Springs, near Fort Wingate, New Mexico.
137.	kom:quekate/a or k/olink/a-ya	Two kilometers south of Zuni Pueblo. Place of emergence of Kiaklo.
138.	tamelauk/a-ya	#138 to #146 are place names between #17 and #11 in order of sequence in prayers and songs.
140.	latawk/a-ya	See #138.
141.	/upulem/e	See #138.
142.	pa/tsitchina:wa	See #138.
143.	to:papik/a-ya	See #138.
144.	k/ashitak/a-ya	See #138.
145.	molank/a-ya	See #138.
146.	haten:k/a-ya	Another name for #11.
147.	/atsina:wa	Four kilometers southwest of Zuni Pueblo near point of the Mountain on Paiya Mesa.
148.	/alhapatse/a	Near #147.
149.	pi:shu/k/a-ya	Spring, four kilometers due south of Zuni.
150.	k/a-nulhe/a	Very near #149 to the east.
151.	k/a:techi-/a	Very near #149 and #150 to the east.
152.	/a:yaya/ka	Very near #149.
153.	/itelha:kupk/a-na	North end of #5, base of mesa.
154.	sum:k/a-na	Spring near #153.
155.	wilatsu:k/ank/a-na	Very near #154.
156.	hepatenn/a	Different place than #110, south of Zuni River by Kelsey Trading Post.
157.	sak/ya-yallen/e	Thirty-two kilometers northwest of Nutria along Hogback.

158.	/apak/enshilowemm/a	To west of #157.
159.	yallateyalhtowa	McGaffey, New Mexico.
160.	lhep/tequ/aqu/a	Area west of #158 to Bernard Vangerwagon's Ranch; valley running west and north of Sabino Bar.
161.	billena:wa	Large valley to north of Nutria, parallel to Hogback.

<u>02/26/80 - Fred Bowannie</u>

162.	/atel/ahonn/a	Atarque, New Mexico, located south of #127.
163.	suski:quenk/a-na	Paxton Springs, east of Nutria.
164.	walhpi-a	First Mesa - Hopi Reservation.
165.	/al/ela/a	Second Mesa - Hopi Reservation.
166.	pat/chi:wa	Old Oraibi, Hopi Reservation.
167.	pih/anyalla	South of Reserve, New Mexico, "Beaver Creek" or Mountain.
168.	hek/oyall/a	Three kilometers southeast of Fence Lake, New Mexico. "Hill with Natural Basin."
169.	talapa/k/a-na	"Grasshopper Springs" four kilometers north of Nutria.
170.	k/a:techik/a-na	"Stinking Spring" 11 to 12 kilometers north of Nutria.
171.	/achiya:tek/apoa	"Knife Hill" in Forest Unit, southeast corner of the Zuni Reservation.
172.	heshot/emk/osk/wa	Box S Canyon, four kilometers east of Nutria.

<u>02/26/80 - Chester H. Gasper</u>

173.	So/que/a	Twenty-seven kilometers east of Ojo Caliente; twenty-seven kilometers south of Zuni Pueblo.
174.	Ketchipa:wa	Three kilometers northeast of Ojo Caliente.
175.	Hawikuh	Three kilometers northwest of Ojo Caliente.

02/27/80 - Oscar Nastacio

176.	halona:wa	Near Kelsey Trading Post, south side of Zuni River in Zuni Village.
177.	/aweshoyallawe	"Moss Mountains" refers to all the mountain tops.
178.	toloknan/a	Spring adjacent or next to #150, eight kilometers south of Zuni.
179.	/onan:telhaqua	Eight kilometers south of Zuni around small ridge.
180.	/onpon:pi/a	Four to six kilometers southeast of Zuni across from #5.
181.	panetan/emm/a	Nine kilometers west of Zuni Pueblo, near gravel pit.
182.	/anelha:we/emm/a	Six kilometers west of Pueblo and south of Hill Ranch Road.
183.	sum/asho/kta	Near #182 within six hundred meters.
184.	/a:k/ohanna/ten:wa or /a:k/ohan/emm/a	Two kilometers south of Zuni Pueblo.
185.	k/eyate:wa	"Place of Thirst" after #114 in painted desert.
186.	yalla/lhi/ann/a	"Blue Mountain" to northwest of Shiprock, New Mexico, to north of #118.
187.	/ashokta:piyan/a	After #128 going east at small Mexican town.
188.	sanana:wohann/a	Between Ramah and El Morro, "Where the Bells are Hanging."
189.	tsi:k/auk/osk/a	Southeast of Fire Tower in Zuni Mountains at head of canyon which runs to lava flow.
190.	sha:k/aya	Mountains south of Acoma.
191.	k/emayak/a-na	Very near #76 at end of #57.
192.	awatu	Hopi Village near Keams Canyon.
193.	ko:chali:wa	Mountains north of Nutria near #158.
194.	wilatsu:qe/a:wanyalla:we	Apache Mountains part of #29.

San Francisco Peaks near Flagstaff, Arizona. It is an area that members of various curing societies visit periodically for specific kinds of medicinal herbs. There is no set time for collecting.

tewanque:k/apa/chuyallan/e - The mountains or peaks toward the sunrise (Mount Taylor). They are used the same as the San Francisco Peaks. The medicine societies come here to collect herbs, the Bow Priests to make offerings on behalf of the war gods, and the council of the gods - the Long Horn - to make offerings for a good year.

k/ak/alianyallan/e - Eagle Peak, in the Tularosa Mountains, south of the reservation. This area is used periodically by the na:we:que (Galaxy Society) during initiation ceremonies. It is also an area used for hunting. Before going on the hunt, prayersticks are offered by the hunter in the area of the hunt. When the hunter gets his game, he makes offerings of prayermeal where he killed his game. It is also an area for collecting medicinal herbs by the curing societies. In times past, it was a place or shrine for the Twin War Gods.

sa:to:yallan/e - Hardcastle Peak. Its use is the same as Eagle Peak's.

piliayalla:we - This is Willow Peaks. Its use is the same as Eagle Peak's.

tona:yalla:we - Turkey Mountain in the Guadalupe Mountains. Its use is the same as Eagle Peak's.

/ulalhlhemina:yalla:we - The White Mountains, mountains of perpetual snow including Mount Baldy. Their use is the same as Eagle Peak's.

top/oliya:k/an-na - This is Blue Lake in the Taos Area. It is only a place name in prayer of the Kiaklo:que.

towayallan/e - Corn Mountain, the most sacred mountain in the Zuni Village. Many different shrines are on top and around the base, including a refuge village site, occupied in 1680 and in mythology during the great flood.

aqualhenya:yalla:we - These are the Zuni Mountains, used for collecting blue paint (Malachite), hunting, and collecting herbs.

LATE HISTORIC ADAPTATION TO HIGH-ALTITUDE ENVIRONMENTS: A COMPARISON OF AMERICAN INDIAN AND EUROAMERICAN LAND USE STRATEGIES

John B. Broster and Emily K. Abbink

An awareness of the potential research value of historic archeological data has just begun to be realized within the last decade in the American Southwest. For many years, the publication of the Johnny Ward's Ranch report (Fontana and Greenleaf 1962) was the only substantial document produced concerning the late historic period (1870 to present). However, this is presently changing, with much more emphasis and time provided for historic archeology on most major archeological projects undertaken in the last few years.

One area of historic research still lacking substantial knowledge is the comparative study of the full range of settlement-subsistence strategies employed during the late historic period at the higher elevations of the Southwest. What is known is often incomplete and biased toward the larger and more complex structural sites created by EuroAmericans during the later part of the 19th century. These settlements, generally devoted to hard rock mining exploitation, have been reported by historians and popularizers of the American West mystique. Although these site types make up a considerable and very important data package, little attention has been given to an equally important set of data relating to other high-altitude adaptive strategies and related settlement patterns. Sites generated under this heading are often less complex structurally, related to activities such as stock raising, farming, and lumber cutting, and tied to individual households.

In general, high-altitude sites representing historic activities prior to 1870, the "proto-historic," are difficult to assess for several reasons. While the historic period in the Southwest nominally began in 1540, significant Western cultural influence apart from the Rio Grande was minimal until some 300 years later. Until this time, when horses became widespread and European goods (metal, glass, etc.) generally became available, employed adaptive strategies and related tools had changed little. Nomadic Apache and Ute material culture from the 1700s largely consisted of portable, perishable basketry and leather items, plus stone tools similar in use and appearance to prehistoric debris. Such groups lacked archeologically specific ceramics and architecture characteristic of lower altitude agricultural pursuits.

Secondly, high-altitude land use is typically one of seasonal or single resource exploitation. Such use is not self-sufficient, precluding permanent settlement, and instead is a "get rich quick" strategy dependent upon a larger system, involving food processing and storage, additional food sources, and/or markets. Prior to 1840, high-altitude activities included Indian hunting and foraging, Anglo fur trapping, and Spanish summer sheep pasturage. Later use added hard rock mining, cattle raising, timber cutting, and freighting, all dependent upon the Eastern market system and transportation.

These activities require summer mobility, usually involving an individual or labor intensive group with resource-specific tools and little means for storage or permanency. Often the resources required speedy extraction or harvesting for the greatest return. Pressure from short summer months, seasonal harvesting, and danger to small groups without support served to limit high-altitude activities. As a result, the very nature of the high-altitude exploitation serves to restrict the potential of archeological studies.

Accordingly, historic researchers must often look beyond archeological data to other information sources regarding late historic high-altitude strategies. These sources include archival and oral history. Archival data, such as diaries, newspapers, army and government reports, and county or land claims records, when available are useful but rarely explanatory or complete. Oral history, where possible, can serve to fill in information gaps presented by archival and archeological sources, and is indispensible for explanatory, site and activity specific detail. Archeological and archival sources can confirm oral

history information and the three work together providing research questions and answers. It is essential to include all potential information sources when studying the late historic, particularly at high-altitudes.

Data for this comparative analysis originated from four sources encompassing two rather extensive projects. The first set of data was derived from large sample surveys conducted between the fall of 1978 and the summer of 1980 on Indian lands by the Forestry Archeological Program of the Bureau of Indian Affairs. To date, archeological investigations have been completed at high-altitudes on the Acoma Pueblo lands and the Mescalero Apache Reservation, and one season of field work has been completed at the Jicarilla Apache Reservation (Figure 35). These surveys have been undertaken within potential timber sale and reseeding areas at elevations of between 6500 feet (1982.5 meters) and 9000 feet (2745 meters). Areal coverage has consisted of 2720 acres at Cebolleta Mesa on Acoma Pueblo lands, 21,600 acres at the Mescalero Apache Reservation and 12,100 acres at the Jicarilla Apache Reservation (1101, 8742, and 4897 hectares, respectively).

Information of EuroAmerican settlement-systems in southwestern Colorado will be utilized for comparative purposes. This data was gathered by the junior author during the fall of 1979. The study area is the Ridgway Reservoir construction site, formerly part of the Ute Indian Reservation, located between the towns of Montrose and Ouray in the Uncompahgre River Valley in west central Colorado (Abbink 1980). Elevation ranges from approximately 6500 feet (1982.5 meters) to 8500 feet (2592.5 meters). Information was obtained not only about the major industries of mining and the railroad but oral histories concerning the farming and ranching aspect of the local EuroAmerican population were also collected.

This paper will compare the differences and similarities of high altitude reservation adaptation in New Mexico with the development of Anglo settlement in similar environments in Colorado. The differences between the three New Mexico reservations will also be considered as a major part of this research.

ACOMA PUEBLO: THE CEBOLLETA MESA SURVEY

Cebolleta Mesa is located on the southern end of the Acoma Embayment some 20 miles (32 kilometers) south of Grants, New Mexico. The mesa is geologically considered a part of the southern San Juan Basin, containing approximately 110 square miles (285 kilometers2) of land surface. This sandstone mesa is capped with a volcanic lava flow probably formed by the Mt. Taylor erruption. Numerous lakes or playas are located on the southern and eastern portion of the mesa (Arany n.d.:3-4). These lakes were perhaps the most critical resource affecting site location on the mesa from PaleoIndian occupation to the present.

A total of 108 historic sites were recorded during the survey of the area (Table 23). They ranged in time from approximately 1760-1979, with the majority, 74 (68.89 percent), post-dating 1960. The early date of 1760-1820 is somewhat misleading (and therefore not included in Table 4) in that it was obtained from several sherds found on a site dating primarily to the early 1900s. These may be curated items picked up by the herders who produced this site.

At least 17 of the sites designated as camps and the one homestead/ranch represent Acoma sheep herding activities. Additionally, four corrals and 10 miscellaneous sites were recorded and probably associated with sheep or goat herding functions. We believe that the majority of unidentified camps are probably also related to herding activities. Two corrals are of a size and construction such that they probably also related to herding activities. Two corrals probably served as horse or cattle pens. Cattle ranching operations were observed in process within the area during the survey. It appears that goats and sheep are still herded on the lower bench of the mesa and within the drainages leading from the mesa proper. During the 1979 field season, both Acoma and hired Navajo herders were observed herding sheep along one of the major rincons on the mesa's southeastern side.

The herding camps usually contained one or more brush structures or tents with an associated brush corral nearby. Three isolated sweatlodges located fairly close

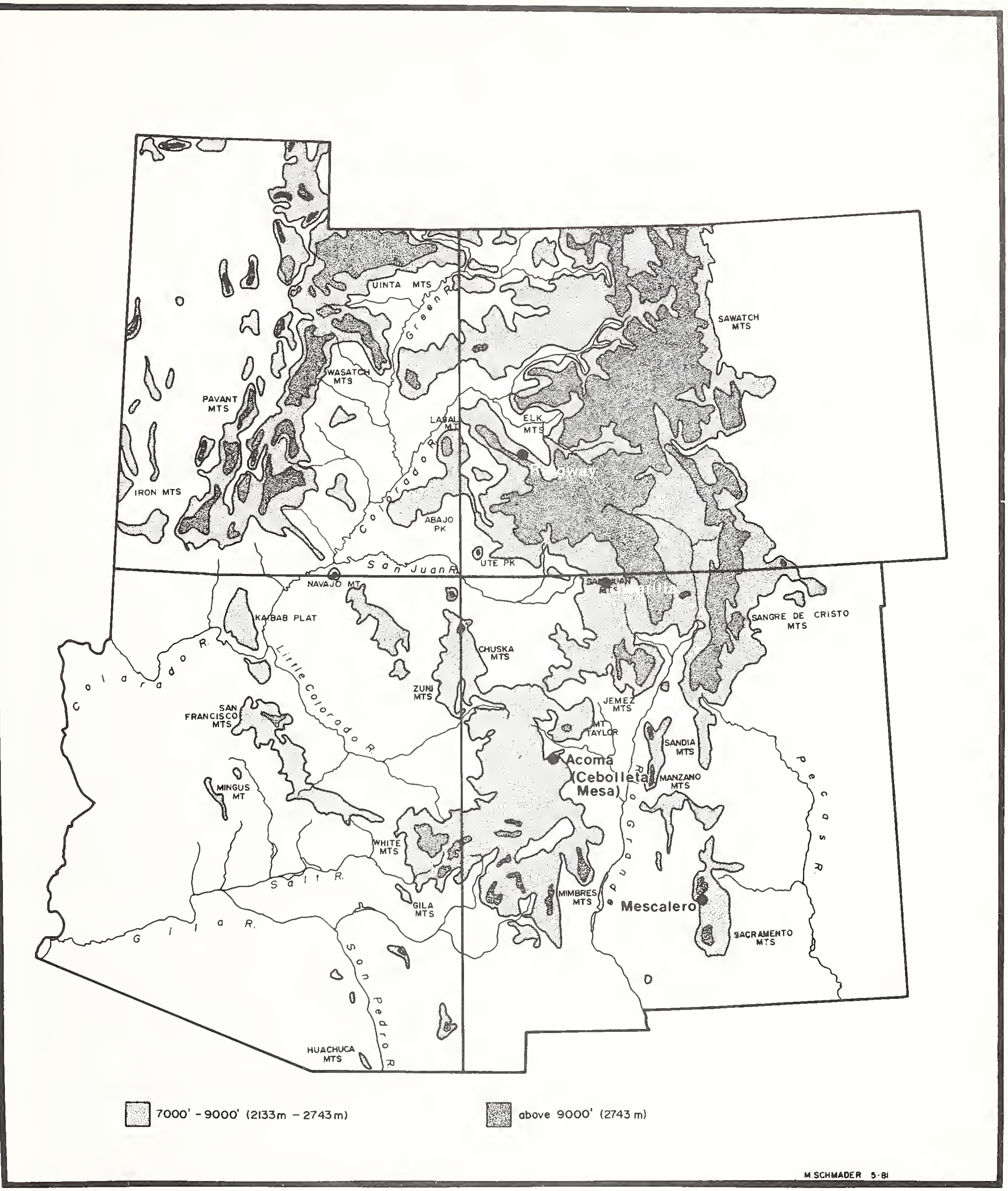


Figure 35. Historic Survey Areas at High-Altitudes in Colorado and New Mexico.

Table 23. Acoma Historic Sites

Site Type	Number	Dates (Range)	Elevation (m) (Range)	Area (m2) (Range)	
Homestead/ Ranch	1	1880-present	2,130	5,000	
Camps/structure(s)	44	1900-1979	2,352.8-2,523.6	36-9,000	
Camps/Hearth(s)	14	1900-1979	2,383.4-2,529.7	1-3,000	
Camps/No structures	21	1900-1979	2,435-2,542	2-1,080	
Logging Camps	2	1940s-1960s	2,523.6-2,526	676-1,000	
Hunters' Stations	3	1900-1979	2,413.8-2,514	1-2,500	(+prehistoric)
Corrals	6	1900-1979	2,158-2,514	42-4,000	(+prehistoric)
Animal Husbandry	10	1900-1979	2,145.6-2,533	1-3,900	(+prehistoric)
Sweatlodge	3	1950s-1960s	2,435-2,446	6-1,000	(+prehistoric)
Geological Tests	1	1979	2,426	200	
Isolated Pinyon-Robbed Hollow Trees	2	1950s-1960s	2,514-2,516	1-4	
Trash Dumps	1	1965-1979	2,438.2	150	

to herding sites are probably associated with Navajo herders hired by the Acoma.

All of these camps appear to date between 1940 and the present, correlating with the fact that the Pueblo of Acoma did not obtain ownership of most of Cebolleta Mesa until the late 1930s or early 1940s. In general, stock raising did not really become an important economic pursuit until World War I. However, the wool market slumped rather badly after the war with the bottom falling out in 1930 (Dismuke 1940:130; Minge 1974:89).

In 1935, a program of stock reduction was introduced which was supported by the U.S. Soil Conservation Service and the tribal councils of Acoma and Laguna. The Acoma herds were reduced from 31,000 to 8000 herd of sheep and goats. Some of these sheep were actually transferred to newly purchased lands in the late 1930s rather than destroyed. This was probably the main reason for the purchase of the Cebolleta Mesa Lands during this period.

Three isolated hunting sites located on the edge of the mesa date between 1900 and the present. Although the dependence upon hunting and gathering declined after the middle of the 19th century, many Acoma presently hunt deer on and around Cebolleta Mesa (Walt n.d.:2-3). Hunting provides a useful meat supplement but it is also considered recreational for Acoma men. Hunters were observed on the mesa in the fall of 1978 by the archeological survey crews.

The third major utilization was represented by 15 sites located on the margins of Brush Mountain on the southern end of the mesa. These sites contain the remains of circular brush and log structures. Although these sites are in an area where sheep corrals and other herding behavior were observed and recorded, it is felt that they probably, at least during part of the year, functioned as pinyon gathering camps. They are possibly associated with a large pinyon gathering episode which took place at Brush Mountain between 1927 and 1934 (Ellis 1974:222-223). Navajo as well as Acoma were supposed to have taken part in this activity.

The Acoma built shelters of vertical logs for their own pinyon picking excursions. These structures were approximately 3.75 meters in diameter and usually circular in plan. A pinyon picking party usually contained several men and a few women. Wooden sleds for hauling the nut crop were located around several of the structures on the mesa. Evidently a small circular structure was often built by both Acoma and Navajo for storage of nuts until time for removal from the area. None of these structures were identified for certain during the survey. However, numerous piles of cones and nut shells were observed. Two isolated pinyon-nut-robbed hollow trees were also recorded. This type of site usually consists of a tree which had been used by animals for storage of pinyon nuts. A panel of wood approximately 40 cm square was cut with an axe from the side of the tree and the nuts removed.

Some general observations about the utilization of the mesa environments are now in order. Although the elevation of the mesa is generally above 8000 feet (2438.2 meters), the terrain is not what would be expected at such an elevation. Except for a few cinder cone formations (e.g., Brush Mountain and Pelon) the dominant land form is one of rolling hills and plains dotted with some 80 to 100 natural lakes or playas. The major vegetative cover conforms to the Transitional Zone with the major trees being pinyon and juniper. Only around the higher elevations of the cinder cones are ponderosa seen in any great numbers.

To some extent, the vegetative cover may reflect logging activities which were conducted during the late 1930s to early 1940s, probably just before the transfer of land to the pueblo. Two such sites were recorded during the field investigation. Some limited logging has been carried out on the mesa since this time.

The majority of historic sites are generally very late in time and are concentrated either around Brush Mountain or along the higher margins of the playas. These playas were especially important to herders, since many still retain large, seasonal volumes of water.

MESCALERO APACHE RESERVATION: TIMBER SALE SURVEY

During the summer of 1979, the Bureau of Indian Affairs located and documented 64 historic sites within a 135 sample block (160 acres/65 hectares each) timber management survey at the Mescalero Reservation (see Broster and Harrill, this volume). Like Cebolleta Mesa, the majority of sites clustered in time between 1950 and the late 1970s (Table 24). No historic materials or sites were encountered which dated to the earliest known historic occupation of the general area. The earliest dated sites from the survey probably ranged from 1880 to around 1917. The occupations are generally very ephemeral and do not represent large scale utilization of high altitudes during this period (Broster 1980:133-134).

These early occupations were probably related to hunting and small scale herding activities. These camps, because of their limited nature, could represent either EuroAmerican or Mescalero occupations of this zone.

The years between 1917 and 1940 saw a continuing increase in the number and complexity of historic sites above 7000 feet (2133.4 meters). The largest and most noticable sites are the EuroAmerican logging camps and associated railroad lines and spurs running through the valleys and canyons at the higher elevations. Six of these sites found during the survey date between 1921 and 1939. The first commercial timber sale at Mescalero was in 1920 in the Elk-Silver Creek timber unit (Hertel 1980:72-73). Evidence of timber cutting and hauling is very prominent above 8000 feet (2438.2 meters), especially in the southern portion of the reservation.

Sawmills and logging camps were usually located in high narrow mountain valleys, with spur lines connecting them with the main line running to Cloudcroft, New Mexico. In general, the camps were in close proximity to permanent sources of water. Often these sites are rather reduced due to the use of these water sources for stock raising activities after 1940.

Organized stock raising did not start at Mescalero until 1914, when the first tribal herd was purchased for the Indians. Nine

Table 24. Mescalero Historic Sites

Site Type	Number	Dates (Range)	Elevation(m) (Range)	Area (m2) (Range)
Homestead/Ranch	3	1880s-1960	2,072.5-2,365	1,000-8,000
Logging Camps	6	1880-1949	2,121.3-2,621	72-500,000
Camps/Structure(s)	3	1934-1964	2,231-2,328.5	100-108
Camps/Hearth(s)	3	1880-Post 1979	2,157.8-2,340.7	4-1,000
Camps/No structures	11	1800-1970s	2,069-2,456.5	2.5-40,000 (+prehistoric)
Stone Alignments	2	1930s-1970s	2,130-2,406	6.5-56
Corrals	9	1917 ± Modern	1,972-2,621	15-1,500
Flood Control Spillway	1	Late 1930s?	2,204	126
Erosion Control Dumps	3	1920-1934+	2,243.2-2,377.3	61-580
Trash Dumps	22	1930-1970s	2,170-2,541.9	4-1,900

corrals were found during the survey, with several of the recorded camps possibly related to relatively recent cattle herding and horse raising.

Cattle and horses were observed during 1979, and were located over a fairly wide area on the reservation. The cattle are communally owned, while the horses appear to be the property of individuals. Sheep raising seems to have never been very important to the Mescaleros, and apparently does not hold the prestige that ownership of cattle conveys on their owners.

The most frequently encountered historic sites were the extremely numerous late period trash dumps. Twenty-two of these sites were represented and dated from post-1904 to the late 1970s. However, of the total number, 16 dated no earlier than 1960. These dumps contained the usual household residue and trash and were generally deposited along tributary canyons of Cherokee Bill Canyon and other major drainages. Most indicate one episode disposal activities, amounting to the quantity of trash that one truck could carry in a single trip.

The lack of many relatively early historic sites at Mescalero can be attributed to several factors. The first of these is that until the late 1920s reservation policy had been to congregate the Indians around the community of Mescalero and a few other settlements located at lower elevations.

It was in the 1920s that there was a dispersal of individual families into farms or ranches. These units were usually oriented around the raising of cattle and hay crops. Of the three recorded ranches/farms, two dated no earlier than 1930. The third was actually at the lowest elevation of the survey, and predated ownership of the specific area by the Mescaleros. Material culture from this site dated from the 1880s to the early 1900s. Indian reuse of the ranch appears to have taken place up until the 1930s.

After the early 1950s, there was a movement out of these individual ranches back to the settlements at Mescalero and Carrizozo to take advantage of available housing provided by the government. The majority of the Mescalero population is now concentrated in these areas. Very few outlier homes were noted during the 1979 survey.

Another factor and possibly the most important for the few early sites can be attributed to the proximity of the reservation to the area of the Lincoln

County War of 1878-1881. Armed groups of EuroAmericans, representing both factions involved in the commercial/range war, travelled across the reservation at will during this time. They often stole stock and on one occasion actually murdered the Assistant Agent and some of the Mescaleros (Broster 1976:11-15).

JICARILLA APACHE RESERVATION: TIMBER SALE SURVEY

In the summer of 1980, some 76 survey blocks (160 acres/65 hectares per block) were inspected for archeological remains on the Jicarilla Apache Reservation. A total of 66 historic sites was investigated during this survey (Table 25). A higher number of these sites predate 1920 than were found at either Acoma or Mescalero. These early sites are associated with both EuroAmerican and Jicarilla Apache occupation within the present boundaries of the reservation.

Two actual historic Victorian towns were mapped and recorded, both of which were related to EuroAmerican utilization of timber and coal resources on the reservation. The first of these towns was called Navajo and was constructed in about 1881, approximately 6 years before the Jicarilla Reservation was formally established. It was built as a coaling and water refueling station on the Denver and Rio Grande Railroad between Chama, New Mexico, and Durango, Colorado (O'Rourke 1980:94).

The second town, called Halfway Tank, was probably constructed around 1904, and it was in existence until about 1917. However, the water tank from which the settlement derived its name was maintained until the late 1920s. This town was established when the railroad line from Lumberton to the El Vado lumber mill was built by Edgar M. Briggs and his partners in association with the Denver and Rio Grande Railroad. The line officially became known as the Rio Grande and Southwestern (Chappell 1971:83).

The narrow gauge line of El Vado was constructed across the reservation in 1904; use was discontinued in 1907. However, it was reopened in 1914 and was in sporadic use until 1928. This railroad carried lumber, supplies, and even passengers from Lumberton and the reservation to the New Mexico Lumber Company town of El Vado (Ibid:83-85).

Another narrow gauge line was noted during the survey running south from Dulce, New Mexico, to Burns Canyon on the reservation. In the spring of 1916, the Pagosa Lumber Company built a lumber mill at Dulce. Machinery and equipment for this mill were moved from Pagosa Springs, Colorado, where the mill had been closed for lack of marketable timber.

A railroad line was built south from Dulce during that same year, and was in use until 1926 when the Pagosa Lumber Company, then owned by Edgar M. Briggs, went out of business. The mill in Dulce shut down in 1924, but a smaller one was constructed in Burns Canyon, which had a capacity of 25,000 board feet per day. They were primarily producing railroad ties at this time. These were considered almost the same as money, and the Pagosa Lumber Company was definitely in need of ready cash during the 1920s (Harley 1924:2). In the same year, the Agency sawmill cut 150,000 board feet of lumber, with all of the cutting being done by Jicarilla Apaches at the rate of $1.00 per thousand (Ibid:6).

As of 1926, approximately 72 percent of the virgin timber on the reservation had been harvested. The remaining timber was located in La Jara Canyon and the extreme heads of Burro and Campanero Canyons. Smaller stands were still located on the southeastern part of the reservation, and in canyon tributaries of the Navajo River (Drissen 1926:1-2). Over the years much of this timber had gone into the construction of buildings at such towns as Durango, and McPhee, Colorado.

The most extensive use of timber was in the manufacture of railroad ties for the Denver and Rio Grande and the Rio Grande and Southwestern Railroads. Approximately 3000 ties, 6.5 feet (2 m) by 6 in (15 cm) square were needed per mile (1.6 km) of track (Chappell 1971:7). This does not take into account the lumber needed for testles and water tanks.

There is no doubt that the clear cutting of timber during the first two decades of the twentieth century had long term, harmful effects upon the economy of the Jicarilla Apache Tribe. This era, known as the age of American Victorianism, had long reaching effects upon Native American populations in

Table 25. Jicarilla Historic Sites

Site Type	Number	Dates (Range)	Elevation(m) (Range)	Area (m2) (Range)
Towns (Railroad/ Logging/Mining)	2	1881-1920+	1,999.3-2,304	4,000-6,000
Homestead/Ranches	13	1887-1960s	2,103-2,462.6	300-9,000
Camps/Structure(s)	15	1900-1980	2,145.6-2,444.3	40-7,000(+prehistoric)
Camps/Hearth(s)	2	1950-1970	2,157.8-2,182.2	2-250
Camps/No structures	15	1887-1970s	2,133.4-2,279.7	10-7,000
Rock Alignments	1	1930-1935	2,170	100
Rock Cairns	1	1950+	2,352.8	4
Corrals	5	1920-1970s	2,194.4-2,438.2	30-2,100
Animal Pens/Traps	1	1960-1970s	2,535.8	4
Trash Dumps	9	1950s-1975	2,243.2-2,499.2	1-150
Sweatlodges	1	1920s	2,267.6	6
Rock Art	1	1967-1969	2,523.6	1

effects upon Native American populations in the entire Southwest (Baker 1978b:11). The economic stress created during this period is still evident among the Jicarilla.

Conversely, the short term effects of the timber business were not as unpleasant. Coming at a time when reservation life in the Southwest was generally at its lowest economically, the railroads and lumber companies provided the Jicarilla with wages as track crews, loggers, and loaders of log trains at the lumber sidings (Chappell 1971:108). Also, as almost all log hauling and loading was done with teams of horses, many of the Jicarillas were able to produce cash crops of fodder.

A total of 12 ranches/farms was located within the sample area. An additional 14 camps with structures were recorded, and five smaller ephemeral camps were documented within the survey blocks. Eight of the ranches and 16 of the camps dated to the "Golden Age" of logging in the area (1895-1917).

In general, these sites showed a greater number of material culture items than would have been expected for early reservation period sites. The complexity and variety of items made some of these ranches appear like an advertisement for an early 1900s Sears-Roebuck Catalogue.

We would agree that the Jicarilla Apaches were extremely poor during this time as compared to their EuroAmerican neighbors (Gunnerson 1974:149-152). Not only were they economically disadvantaged, but by 1914 approximately 90 percent of the population was suffering from tuberculosis. However, this period from 1900 to the early 1920s was relatively prosperous as compared to earlier times. The final collapse of the timber industry did bring about the lowest ebb in tribal fortunes some 30 years after the establishment of the reservation.

The Jicarilla Apaches remained a dispersed people until the 1920s. This can be substantiated by the numberous ranch/farm remains observed both within the sample blocks and outside the sample domain. After this time, there appears to have been an attempt to move the Apaches into the settlement of Dulce. In the period from 1887 to 1920, the Apaches were generally

subsidized by government rations and by sporadic employment with the lumber and railroad companies.

Major economic reliance on livestock raising by the Jicarilla Apaches spans the time from 1920 to the middle of the 1950s. The reservation sheep population increased until 1943, when it numbered 38,654 head. This figure has steadily declined to the present day, with only 15,768 sheep counted in 1959. In 1974-1975, only 10 households earned their income from stock raising. A total of just 5729 sheep were listed in 1974, with half of these owned by six men (Cattle, Carroll, and Stuart 1981:43-46). Navajo were often employed by the Jicarilla Apaches as herders and workers on shearing crews from 1920 to the late 1950s.

Cattle ownership, at Mescalero, confers greater prestige than sheep (Ibid:46-47). Many more cattle and horses were seen on the reservation than sheep during the 1980 archeological survey.

The reservation has been divided into summer and winter ranges. The northern or forested portion is best for summer grazing. Most of this part of the tribal lands is allotted to individual families. During the 1920s, very little of the southern addition was used by the Jicarillas. Some nine townships were leased to outside cattle and sheep owners. A total of 500 cattle or 2500 sheep were allowed to graze per year on these lease areas (Drissen 1926:10).

The population of the reservation is much more concentrated at present, and is located primarily in the town of Dulce. Only a few, usually older individuals, still maintain residences in ranch/farm situations outside of Dulce. Economic problems are still very apparent among the Jicarillas. Unemployment may run as high as 70 percent on the reservation. The isolation of the Jicarilla Apache and the underdevelopment of a possible tourist trade have made wage labor jobs on the reservation very difficult to find for the average resident.

UNCOMPAHGRE VALLEY: THE RIDGWAY RESERVOIR STUDY

The data for this section were collected in the fall of 1971 for the Bureau of Reclamation's Ridgway Reservoir Project. This study, the Dallas Creek Oral History Program, in conjunction with archeological mitigation, focused on historic architectural and archeological remains.

The reservoir sites represent several specialized economic activities including placer-mining, freighting, the mercantile enterprise of the town of Old Dallas, and the surrounding farms and ranches within the valley. A total of 171 potential informants were contacted regarding these sites, of whom 51 were interviewed at least once. Information was gathered on 5 towns and 18 archeologically documented homes and ranches. Data on house plans, ranching and farming activities, and placer-mining were also obtained from informants.

Uncompahgre Valley settlement was unique in that local towns were established prior to or during rural development. While the exploitative strategy of hard rock mining did not require land development per se, it did depend on towns to provide supportive and transportation services. Articulation with the Eastern socio-cultural system was never completely severed as in true frontier situations. This characteristic of Western Slope development in general is attributable to the high, dry rocky terrain more conducive to mining than to farming, and the valley's Indian reservation status, retained until 1881, which precluded settlement by EuroAmericans.

Initially, the 1868 Treaty reserved nearly the western third of Colorado, including the San Juans, administered by Ute Agencies at White River and Los Pinos. By 1873, sufficient pressure mounted from mining groups to free a 96 km by 120 km tract in the San Juan Foothills for settlement just south of the Ridgway study area (Borland 1951:107-108). Soon the southern Los Pinos Ute Agency moved to the Uncompahgre near Cow Creek, north of the reservoir, to prevent further mining encroachment (Ibid:128).

By the late 1870s the San Juan mining towns of Silverton (elevation 2829 meters), Ouray (elevation 2348 meters), and Telluride (elevation 2055 meters), were booming and the "mining triangle" formed by these three required supplies, services, and agriculture support. Despite the proximity of the Uncompahgre Agency (near present day Colona), both mining and agricultural trespass occurred frequently as

Ouray's population overflow sought new strikes and irrigable land. In 1877, gold was discovered near the mouth of Dallas Creek along the Uncompahgre. Although it was reservation land, a tent camp called "Gold City" quickly sprang up followed by the founding of the town of Dallas (elevation 2104 meters), before the agency could serve eviction (Jocknick 1968:244). Other placer locations were also staked and worked on the reservation. Such encroachment plus the massacre at the White River Agency to the north fostered the establishment of Fort Crawford in 1880. Increasing pressure from gold-hungry miners and farmers who saw the mines as a steady market, succeeded in abolishing the Western Slope Ute reservation in 1882. Fort Crawford insured the Utes' safe removal to Utah preventing overly eager settlers from breaking ground until they had moved (Nankivell 1934).

Both the mines and Fort Crawford needed freighted supplies, which encouraged the establishment of stores and services to provide goods, hotels, restaurants, and stables. Both Ouray and Telluride required transport systems to market ores. Soon Dallas (5OR69), Montrose, and later Ridgway became terminals for wagon and railroad freighting. Colona provided goods and services for the military and their families. By the late 1880s, a small town was located approximately every 10 miles (16 km) up the Uncompahgre River Valley. The study area ecompasses the former, town of Dallas and surrounding ranchlands toward Colona (elevation ca. 2133.4 meters).

Most town dwellers had moved directly from Italy and Austria to work the San Juan mines. Rural Uncompahgre farmers and ranchers came largely from the midwestern states of Missouri, Wisconsin, Illinois, and Iowa. Some families were already living in the San Luis Valley area, in eastern Colorado, when the West Slope reservation opened. Mormon settlers moved east from Utah to farm and later, miners turned cattlemen moved north from the San Juan mines to less rugged grazing lands.

Frontier Towns of the Uncompahgre River Valley

Ouray

Like other mining towns, Ouray's prices were high and services included laundrys, restaurants, hotels, 27 saloons, and a thriving red light district (Hill and Davis 1978:46). Although Ouray was the county seat, few rural residents traded there except for county business, preferring Dallas or Ridgway, as prices were too high. Ouray was the market for local produce, however, including hay, eggs, dairy products, beef, and vegetables. Ouray and Colona had the only high schools until Ridgway High School opened around 1912.

Ouray's population, like Silverton's, Telluride's, and Rico's, in the surrounding San Juan Mining District, was mainly Italian, Austrian, Yugoslavian, and French groups (Gruebel 1978; Hill and Davis 1978; Overholser, Hicks, and Jackson 1979). These groups had immigrated to the Colorado mines in response to mining advertisements published in their homelands. Mining-related occupations also solicited blacksmiths (for mending and sharpening equipment), carpenters, and stonemasons. Many Chinese laborers, former railroad workers from the west coast, ran Ouray's laundries.

Ouray also supported many freighters and hunters, mostly Americans from the East who furnished the mines with supplies and food. Freighters started packing provisions by wagon to surrounding mines around Labor Day. Supplies were stored in huge 30 to 61 meter long underground cellars to last through the winter and spring (Overholser, Hicks, and Jackson, 1979). Ouray was also the headquarters of the County sheriff's office. Since the 1940s, Ouray has declined markedly and today it functions more as a tourist and recreation attraction.

Portland

Portland gained importance in the 1870s as the chief trade center for the "Parks," which was the only available farmland adjacent to Ouray prior to the opening of the reservation in 1882 (Jocknick 1968:151). Farming the "4-mile strip" wedge between the mining district and reservation was lucrative; miners paid well for such produce as cream, butter, eggs, vegetables, and strawberries. Founded by the Hotchkiss brothers, landowners near Colona and Log Hill Mesa, Portland anticipated a brisk railroad business. However, Ouray acquired the terminal and by 1912, with the silver decline, Portland died as a town. In its heyday, it included a

one-room school, hotel, general store, several houses, and freighting stables. Residents worked in the Ouray mines or maintained small "truck" farms well watered by Ouray County's water priority from Cutler Creek.

Placer-Mining

In the late 1870s miners from Ouray and Silverton streamed into the Dallas Creek area, then still part of the Ute Indian Reservation, in search of placer gold. Placer mines were soon located along the Uncompahgre River, mostly between Cow Creek and Ridgway, where glacial gravel deposits were largest. In the late 1880s and early 1890s many placer claims were patented in the area (Ibid:10-7). Claims were filed according to mining district regulations (in this case the Uncompahgre District) as determined by the United States Geological Survey. For the most part, placer-mining activities in the area are not well documented, probably due to lack of success.

The Pericles Placer Mine, worked in the 1880s, while never very successful, was probably responsible for encouraging white infringement of the Ute Reservation to within six miles of the Colona Agency in 1879 and 1880 (Baker 1878a:72). Most gold panning occurred between 1880 and 1930. Placer miners usually shoveled the coarse gravels into a carpeted sluice box washed with water provided by a placer ditch. The gold settled down into the carpet while the dirt ran out and the water ran through. Sometimes, hydraulic pumps were used to pump wash water over the gravels especially in large placer operations.

One of the most famous Uncompahgre placer operations was the Old China Mine, worked mostly by Chinese brought to Dallas with railroad construction crews in the 1880s. Chinese families often built houses on the river at the placer site, using the "Old Placer Ditch" at the foot of Log Hill Mesa to wash gold. The families often worked in Ridgway at the Chinese laundry. Until about 1905, the Chinese washed enough gold to make a living, and usually sold directly to the Ridgway Bank.

The best ranches and farms were established soon after 1881 if not before. Non-reservation farm land in the Park (south of the survey area) and ranch land near Fort Crawford (north of the survey area) had already been settled. Newly freed river bottoms, including those adjacent to the Uncompahgre, Cow Creek, and Dallas Creek, were developed next. Accordingly, the settlement sequence of local ranching communities began with the Park and Colona (pre-1881), followed by the Uncompahgre, Pleasant Valley, Cow Creek, Alkali Creek, and Dallas Valley, all within several years. Water proved the crucial factor. Colona had the best and most water and a slightly longer growing season than Cow Creek or Dallas. Around the turn-of-the-century the Western Slope experienced another push for land and much of the higher, drier "free range" including Log Hill Mesa and Dallas Divide was taken up (Baker 1978a:49). This land was used more for farming than ranching, however.

Few ranchers patented land until ready to sell, partly to avoid taxation. As most of the Western Slope had been reservation, land settlers were required to purchase claims, usually at the rate of $1.25 per acre. Where homesteading was permitted, land improvements, not including the house, had to amount to the total price of $1.25 per acre in the alloted time. Each county had a land office with survey plats of unclaimed lands and outlines of homesteading specifications. Required land development included fences, reservoirs, barns, clearing, plowing, and ditches. Houses had to consist of at least one room with four walls, a door, window, and roof, and be acknowledged by three witnesses. Requirements concerning floors varied. Some ranchers had "squatted" on reservation lands prior to 1881, and received "squatter's title" for utilized land (Abbink 1980:10-5).

High elevation EuroAmerican agricultural settlements, including those on Colorado's Western Slope, were characterized by single-family owned cow-calf operations. These ranches exhibited a seasonal use related to snow cover duration and vegetation periodicity requiring four ecosystems: irrigated meadows, semi-arid range, partially forested hills, and tundra (Crowley 1975:451). Ranch-owned irrigation meadows were crucial to mountain cattle raising, providing hay for 5 months of winter feed plus grazing. Buying hay was economically unfeasible, so mountain ranching required enough irrigable land to raise sufficient winter feed (Abbink 1980:10-6). Semi-arid range furnished only

limited wild feed but at a crucial time in the spring, when cattle had exhausted winter feed supplies, and needed to move from the irrigated meadows. The higher semi-arid range supplied enough grass to support herds before moving upslope to the more lush but later blooming, forested hills. The most productive natural community, the forested hills, provided extended feed for most of the summer. High tundra forests, more important for sheep grazing, played an important role in the early cattle industry by providing necessary irrigation water for hay meadows (Ibid:452-457).

Access to these four ecosystems was a must for early, large scale ranchers, such as those in the Dallas area. During the early free-range era, ranchers had ample access to unclaimed range lands (semi-arid, forested hills, and tundra) through "right by use." Water was also freely taken from the river for irrigation. By the early 1900s, high tundra lands were placed under National Forest Administration, and a system of forest grazing permits began (Ibid:337). As tundra grazing was not crucial and permits inexpensive, this first step in curbing free land use did not seriously affect early cattle ranchers.

By the 1920s a new wave of settlers had claimed much of the lower, non-National Forest land, the traditional free range source. The Taylor Grazing Act of 1934 withdrew remaining public domain from homesteading and private purchase and require BLM permits for grazing use. While the Grazing Act helped smaller ranches obtain range access, it put many larger ranches out of business by renting and limiting formerly free range and preventing further homesteading.

West Slope ranching proved a profitable venture between 1880 and 1920. The mining towns of Silverton, Ouray, and Telluride provided a good market for Dallas area beef growers. About the time the mines started to fail, the United States Army began purchasing vast quantities of beef to feed World War I troops, and the meat was sent by rail to Denver for processing. After the war, however, many ranchers were overstocked and went broke. The early 1920s beef depression marked the dissolution of many of the large, early established ranching outfits.

This trend continued through the 1930s depression when beef markets were low, although the government bought diseased stock at nominal prices to improve herds. During World War II the Army again inflated meat prices, but difficulties in finding labor and affording mechanized equipment forced many family-owned operations to sell out. Today, competition for land from development and recreation plus economic limitations has all but put the small single family operation out of business.

Farming operations tended to concentrate in the narrow valley around Portland, giving way to ranches south of Ridgway where the valley widens. Farms versus ranches were also prevalent on Log Hill and Dallas Divide. These communities were without sufficient irrigation water to grow hay, the base for mountain ranching. In addition there were longer snow cover, unsuitable vegetation periodicity, and less access to those ecosystems required to support a cow-calf operation.

Both farmers and ranchers raised their own hogs, sheep, bees, chickens, and dairy cows. Ouray and Telluride proved a steady market for meat, dairy products, and vegetables, often delivered by rail. The best local cash crops included rutabagas, beets, turnips, cabbage, potatoes, onions and green beans, apples, and stawberries. Many families grew corn, tomatoes, and squash for their own use.

Because of Ute and Army hunters from Fort Crawford, the reservation was nearly devoid of wild game such as elk, deer, and turkey by the 1880s. Reservoir residents hunted the high ranges but depended on domestic meat. Valley agriculturalists were often troubled by mountain lions and bears killing sheep and calves. River fishing varied due largely to mineral processing waste dumped into the Uncompahgre by the Ouray smelters. Both fish and game are presently making a comeback in the reservoir area (Abbink 1980:10-7).

CONCLUSIONS

While the high-altitude strategies outlined involved resource specific exploitation, in comparing the Ridgway Reservoir data of southwestern Colorado to that of the three Indian reservations in New Mexico, there are some very apparent differences in land use at the higher

elevation zones. The development in southwestern Colorado can be seen as a direct and rather systematic response to the growing railroad and mining industries in that part of the state during the late nineteenth century and the early 20th century.

The regional economy was tightly entwined with the development and subsequent decline of the local mining industry. When the mines began to fail in the 1920s, so did the cattle and farming industries of the Uncompahgre Valley. The early rural settlers were completely tied to the economy of the mining and railroad towns of the region.

The necessity of both ranchers and farmers to meet certain specifications under the Homestead Act lent a certain uniformity to rural historical sites, generally missing from Native American sites from the three reservation surveys. By contrast, the utilization of higher elevations on the three reservations often depended upon government policy and available funding. Thus, development of farming and ranching was not always a direct result of such enterprises. A certain amount of lag time seems to have occurred between the authorization of economic projects and their implementation.

There are several differences between the three Indian groups' utilization of the higher altitude environments. The predominance of herding sites on Cebolleta Mesa at Acoma is quite unlike anything encountered on either of the two Apache reservations. Although generally higher in elevation than sites found at either Jicarilla or Mescalero, those at Acoma are located on a flatter topographic land surface with a vegetative cover of pinyon-juniper parkland, which is more like that found at lower elevations.

Site density was calculated for all three of the Indian land areas based on the timber sale data. A density of 19.8 historic sites per square mile (2 km2) for Cebolleta Mesa at the Pueblo of Acoma, 3.48 historic sites per square mile at the Jicarilla Apache Reservation, and 1.88 historic sites per square mile at the Mescalero Apache Reservation were predicted for the higher altitude zones.

The differences between Jicarilla and Mescalero in terms of site density can be explained in a number of ways. The Mescalero sample was drawn from the most topographically rugged situation of all of the three surveys. The Acoma sample was taken in the most moderate topographic environment, while the Jicarilla sample fell somewhere in between that at Mescalero and Acoma. The high mountain valleys at Jicarilla are much broader than those at Mescalero, allowing for larger stands of potential horse and cattle fodder.

The second reason for the differences in site numbers is that the Jicarilla population was much more dispersed on their lands historically than were the Mescalero. Also, employment opportunities were greater much earlier for the Jicarillas, through reservation logging, than for either the Mescalero or Acoma.

Topographic variability and resource availability seem the critical variables determining site density and complexity at the higher elevations for both EuroAmerican and American Indian populations (Stuart, Anstine, and Broster 1978:13-15). The higher the ruggedness or topographic brokeness, the lower the density of sites for any of the areas under study.

Economic poverty and restricted access to wage labor jobs plus a lack of cash money crops or livestock are extremely significant in understanding the differences between EuroAmerican and Indian groups, probably participated to the greatest degree in the EuroAmerican economic system. However, this was very short lived and was dependent upon an industry which exploited their timber reserves and eventually went out of business with the disappearance of the large timbered forest.

Today, the use of high-altitude in all three Indian reservations is fairly well restricted to stock raising activities. Cattle would appear to be the most important at the Apache reservations, while sheep are the preferred grazing animal on Acoma Pueblo lands. The Ridgway Reservoir is intended for recreational use and water storage.

PART SEVEN: DISCUSSION

HIGH-ALTITUDE RESOURCE UTILIZATION IN THE SOUTHWEST: PROBLEMS AND PROSPECTS

Bruce G. Harrill

The following discussion is a collection of various ideas, problems, and unresolved issues based on group discussions of the various seminar papers and our general discussions of high-altitude resource utilization. Many of the issues raised were resolved during the group discussions and then incorporated by the various authors into revisions of their papers. More general unresolved issues were expanded upon in the general discussions and are summarized here. The ideas and problems which we feel are worthy of further examination fall into three general areas: (1) environment; (2) human physiological adaptation; and (3) resource utilization patterns. Each of these are discussed as they pertain to problems raised in the discussions with suggestions for possible directions for future research.

ENVIRONMENT

Knowledge of the physical and biotic environment at high-altitudes is of primary importance in attempting to understand high-altitude resource utilization. The principal differences in the biological characteristics of high-altitude mountains are due to different climatic regimes as determined by solar radiation, length of the day, temperature, and precipitation. These variables are largely controlled by elevation, latitude, and continental situation. Therefore, the following relationship between elevation and climate would be found on an idealized high mountain range. As altitude increases, temperature decreases, atmospheric pressure decreases, and precipitation increases to a point and then decreases. Steepness and direction of slope, continential climatic patterns, and local topographic situations usually modify these relationships. These climatic and geographic situations usually modify these relationships. These climatic and geographic variables result in vertically zoned climatic characteristics, which along the gradient of a mountain range result in vertical biotic zonation. However, these biotic zones are often irregular due to intervening topographic variables such as topographic complexity, cliffs, slopes, ridges, spurs, and valleys which can alter climatic characteristics and produce microclimates and microniches. Additional considerations such as bedrock geology and soil type may also act to alter the distribution of vegetation types.

Our general discussion of environmental topics revealed three areas which require further elaboration and research. These are: (1) the development of a definition of "high-altitude" for the Southwest which can be employed and/or refined by future research, (2) a clearer understanding of the paleoenvironment at high-altitudes in the Southwest, and (3) a consideration of physiographic factors in examining high-altitude resource utilization.

A Definition of High-Altitude

Worldwide research dealing with high-altitude peoples has considered "high altitude" to be 2500 meters (8200 feet) and above. This altitude limit has been established primarily by physical anthropologists and human physiologists as the altitude above which the human organism undergoes stress and must adapt physiologically in order to survive. This elevation was felt to be inappropriate for our present use as these papers are concerned with the utilization of resources in upland and mountain environmental zones in the Southwest, rather than year round habitation at altitudes above 8200 feet. Additionally, use of the 8200 foot level in the Southwest would preclude considerable land area from consideration. We have generally agreed that perhaps a more appropriate definition might be one involving vegetation zone boundaries rather than a specific elevation. It was suggested that the definition of high altitude for use in the Southwest might be defined as the lower boundary of the Ponderosa Pine Zone and above. This has a variable lower limit ranging from something below 7000 feet (2134 meters) to 8200 feet depending on

latitude, physiographic setting, and exposure. In using such a definition, we should recognize possible vertical shifts in the limits of this and other biotic zones over the past 10,000 years.

Paleoenvironmental Considerations

Hevly has assembled a useful summary of the resources, environmental characteristics, and possible changes in environmental zones on the Colorado Plateau near Flagstaff for the period A.D. 500 to 1400. This would provide a very useful model for other high-altitude areas in the Southwest, but the applicability of this model will require some regional verification. This can be done through compilation and comparison of existing environmental data supplemented by additional field data.

High-Altitude Physiographic Types

Cordell has suggested that a worthwhile approach to high-altitude research might be to examine the size of high-altitude environmental zones based on the size and type of mountain or upland masses. As the size of the mountain mass directly affects moisture and subsequently the quantity and availability of resources, it is suggested that such differences may give rise to regional differences in adaptive strategies at all elevations.

HUMAN PHYSIOLOGICAL ADAPTATION

The physiological stress imposed on human organisms at high altitudes (8200 feet and above) is hypoxia, a deficiency in the amount of oxygen reaching the body tissues which is the result of decreased oxygen pressure at high altitudes. This lowered oxygen pressure and resulting hypoxia is considered to impair reproductive efficiency even in long term residents acclimatized to high altitude. It also acts to slow growth and skeletal maturation due to interference with cell multiplication and decrease in the efficiency of intestinal food absorption. The physiological adaptations to this decreased oxygen pressure include an increased chest size resulting in greater respiratory capacity and an increase in the level of functional hemoglobins and circulating red blood cells. It has been demonstrated that these are developmental and acclimatizational adaptations and may not be genetic. In the Southwest there were no year-round high-altitude populations until the historic period. We feel that the findings concerning human physiological adaptations in other regions would hold true for the high-altitudes in the Southwest, if there were actual year-round high-altitude dwelling populations. One interesting effect of high altitudes on human populations which is not well-researched is the decrease in reproductive efficiency at high-altitudes. It is not known at what elevation reproductive efficiency decreases and how fast it decreases with increase in altitude. Studies of historical and contemporary birth records in the Southwest might be useful in elucidating these factors. Such data might then be useful in interpreting prehistoric demographics in the upland regions occupied by agriculturalists.

RESOURCE UTILIZATION PATTERNS

The environmental characteristics of the high elevations in the Southwest place certain limitations on the kinds of resource utilization which may be undertaken. In the southwest mountains the seasonal changes are marked and the high-altitiude zones are productive only during the summer months. This seasonal variation makes altitudes above 8000 feet largely inaccessible for most purposes for about 4 or 5 months. Therefore, above the upper limits of agriculture, subsistence resources are productive and available only on a seasonal basis.

The length of the frost-free period is the factor which seems to define the upper limits of year-round occupation by agriculturalists. The populations have taken maximum advantage of the increased moisture at higher elevations and have often run these agricultural activities hard against their upper limits as defined by the frost-free period. Above these limits of agricultural activity the high-altitude resource utilization patterns are seen to fall into three categories: (1) subsistence oriented resource utilization (basically seasonal hunting and gathering), (2) non-subsistence oriented resource utilization (raw materials, minerals), and (3) religious or spiritual uses (shrines, sacred areas, and gathering of sacred natural materials). The use strategies of these three categories are generally seasonal and short-term.

As archeological manifestations are a reflection of these use strategies, we need to carefully examine the variability in the archeological record at high-altitude sites. During the general discussion of the seminar papers Stuart noted the following general patterns of high-altitude sites:

1. As altitude increases, the artifact assemblages on sites become more generalized, with fewer diagnostic artifacts resulting in a loss of phase identity and regional cultural differentiation.

2. As altitude increases, sites become smaller with less labor investment in site features and artifactual materials become less dense, all due to seasonal and short-term use of the sites.

It was generally agreed upon by the participants that there is a problem in dating sites at high altitudes, but no one was certain as to how we might improve chronological control. It was also noted that information on PaleoIndian and Archaic occupations at high altitudes was not abundant and that additional research on these two traditions was needed. It was suggested that perhaps there is a highland adaptation for both PaleoIndian and Archaic populations in the Southwest. This subject clearly needs closer scrutiny.

It was personally felt by this discussant and several other participants that there is a methodological difficulty in the isolation of high-altitude behavior from the overall behavior system of the same people at lower altitudes. High-altitude resources are the upper limits of the total environment available for utilization and it seems unnatural to separate high-altitude resource utilization and examine it apart from the total environment. Any examination of high-altitude resource utilization should consider it a part of the total subsistence system.

Additionally, the following issues were felt to be worthy of further investigation:

(1) The role of transportation technology in the historic period should be closely studied as a means of allowing increased resource utilization at high-altitudes, particularly in the timber and mining industries.

(2) Formalized exchange and alliance systems may have existed in the prehistoric period which may have facilitated the acquisition and exchange of high-altitude resources as well as had more complex social implications. Evidence for such systems should be carefully examined.

(3) In order to more clearly understand high-altitude resource utilization in the prehistoric period, it may be useful to carefully analyze the historic period for models of high-altitude resource utilization. Such an analysis should include both Native American as well as EuroAmerican uses of high-altitude areas.

SUMMARY

To summarize, it is clear that in order to pursue any of the above-mentioned research issues we need consistent and rigorous methods for recording high-altitude manifestations to insure comparability of data. In conjunction with this we should attempt to carefully define the environmental parameters of our high-altitude study areas and avoid simplifying and generalizing about the envionmental characteristics of a study area. Careful attention should be directed to possible intervening variables, particularly modifying features of topography, such as valleys, and canyons, solar and wind exposure, and cold air drainages which may produce either more or less habitable microenvironments.

The archeological community needs to develop a sensitivity toward possible active Native American religious areas and shrines when reporting upon cultural features at high-altitudes, regardless of the land status. In cases where a feature is suspected of being an active shrine, local tribal officials should be contacted regarding the implications of publishing the descriptions and locations of such features in an archeological report.

In the southwestern United States we are only beginning to utilize the concept of "high-altitude" as a unit of observation and analysis in cultural resource studies. These studies are clearly in the realm of ecological anthropology and thus may borrow many of the terms and concepts from that realm of investigation. Clearly, many of our problems in examining high-altitude resource utilization are in the formulation

or borrowing and application of terms and concepts for such analyses. It would be premature to attempt to strictly define high-altitude types or strategies at this time. The concepts and definitions presented here are only suggestions which will certainly require some further definition and refinement.

MANAGING CULTURAL RESOURCES IN THE HIGHLANDS

Evan I. DeBloois

INTRODUCTION

The discussions and presentations contained in this volume on archeological resources of high-altitude areas of the southwestern United States hold a number of important implications for the management of the cultural resource base, a responsibility that falls largely upon federal land managing agencies. A considerable portion of the high elevation lands in the West is controlled by the Forest Service, the Bureau of Indian Affairs, or the Bureau of Land Management. Any discussion of research goals, information needs, or special problems that involve cultural resources found in high elevations will involve the issue of federal land management policies. Conversely, the development of federal land management policy towards these highlands could have a serious impact upon scientific purposes and aims.

Because of this interrelationship between two sets of goals, there is a need for cooperation and coordination between the archeological community and the federal land manager. Although the two sets of goals are not entirely identical, they are similar and interlinked. The land manager is responsible for the resource under his jurisdiction. It is his job to see that these resources are properly protected, utilized, preserved, harvested, maintained, or removed. As a public official, the land manager must be concerned about the interests of the American public. Because this public is a heterogeneous group consisting of numerous special interests, the public responsibilities of the manager are difficult to clearly state and often impossible to carry out in a manner that pleases everyone. The land manager must, therefore, establish priorities, rank certain uses, and weigh the consequences of each action.

The archeological community is one of hundreds of special interest groups and one of several that have an interest in cultural resources on federal lands. Archeologists are users of the resource and as such must be concerned with or affected by any regulations written about how the cultural resource base will be managed. Mutually beneficial activities could easily be developed that would contribute to the increase of scientific knowledge while at the same time assisting the land manager in arriving at balanced and intelligent decisions about resource utilization and commitments.

The proceedings of the conference on high-altitude archeological sites produced a number of recommendations that have direct application for Forest Service, Bureau of Indian Affairs, and Bureau of Land Management operations. Areas were identified where cooperation between an agency and the archeologists could result in benefits to both. Outputs from federal cultural resource management activities could be increased in quality and quantity, scientific research goals could be met, and the public could benefit from an increase in understanding of the past and in the production of other resources from federally managed lands.

The problems facing archeologists in high-altitude settings are complex and numerous. Environmental conditions are very unstable resulting in slowly forming soils and fragile environments which suffer long-term effects of disturbance. Human uses of high elevations were often sporadic and of short duration. Seasonal uses often required little in the way of special structures or large quantities of tools. As a result many sites possess no visible stratigraphy, no diagnostic artifacts, little resistance to modern disturbance and damage, and high susceptibility to collection bias. In response to this set of difficulties, agency and archeological purposes are very similar. Conservation of important sites requires an ability to identify "important" from "non-important" cultural manifestations. Demonstrating importance frequently requires scientific research. Importance in cultural resource management terms translates to scientific, educational, and interpretive value. Evaluating sites found at high altitudes for management purposes is complicated by the same sets of problems that are faced by archeologists trying to understand what cultural processes occurred in the area. Because of this similarity of purpose, a cooperative approach is much

more likely to succeed than a fragmented approach. Cooperation between federal agencies, state organizations, and academic institutions, will provide the greatest potential for success in the endeavor to unravel the complex patterns of highland archeology in the West.

SITE VISIBILITY

One of the persistent problems faced by cultural resource managers is the lack of visibility of the resource. Are the patterns of site distribution we see the result of contempory patterns of vegetative cover or are they culturally caused? What role does observer bias play in site identification? How do changing light patterns from morning to evening affect the process of locating sites? How does the season of the year affect the number and type of sites located?

It has been common knowledge for decades that seasonality and light angle can seriously affect the ability of the archeologist to identify certain types of archeological phenomena. In spite of this knowledge, most cultural resource inventories are carried out on a one-shot basis. A project is scheduled and undertaken whenever possible. This may mean one project occurs in the spring, another in the midsummer and another in the fall. Some areas are examined early in the day and others late in the afternoon. Although the somewhat random nature of when a field examination is conducted would tend to identify a representative sample of existing resources over time, the implications for the location of any particular resource on a specific project are significant.

Examples are numerous in the literature that document instances where sites have been overlooked due to dense vegetation and other factors. In many situations, inventories do not even attempt to examine some types of vegetative cover, although attempts are made to note areas which were not examined. The questions about unlocated sites take two different directions; first, the manager must assess the potential impact of a project on these unquantified resources, and second, the scientist must assess the impact of these gaps upon models and patterns of cultural processes.

The problem of visibility has taken on considerably enlarged meaning since the institution of legal requirements to locate "all significant cultural resources" on federal lands. Assessing the potential impact of a proposed project upon the resource base is difficult enough without having to worry about sites that are hidden by vegetation, or buried by sedimentation, or disguised by modern disturbance. Can the potential importance of prehistoric resources made invisible by forest litter outweigh the cost of inventory techniques required to locate them? Methods have been devised for locating such sites with some success, but the increase in the inventory costs for such approaches is considerable. The land manager is usually interested in locating the maximum number of sites with the minimum amount of expenditure. In spite of that interest, it is probably true that considerable effort is being expended in the examination of areas which hold low potential for site location due to low site visibility.

Much of the field survey work performed for or by federal agencies is directed at the total examination of the surface area of a project. That legal goal is accomplished whether sites are located or not. However, the motivation behind federal regulations is the protection and preservation of important cultural resources. More effective coverage of a project could probably be obtained by increasing the use of predictive models and sampling strategies. This would allow the use of intensive surface examination techniques on a cost effective basis. It would also provide a statistical basis for analyzing the effect of vegetative cover or other screening phenomena on site visibility. Supplemented with an increase in the examination of areas after disturbance, data could be assembled that would enable the manager and the archeologist to evaluate the degree of skewing caused by screening factors. Examination of burned-over areas, logged-over areas after clearing, etc., would provide verification data for the question of the effect of visibility on site location.

SHADOW SITES

From historical and ethnohistorical records it is clear that many uses of high-altitudes do not result in the generation of an archeologically recognizable record. Many of the historically documented uses of these elevations result in a barely

perceptable material record. When viewed from a prehistoric perspective, what implications does this hold for the correct interpretation of the few, scattered, ephemeral prehistoric sites found in many areas? Are we correct in assuming that the highlands were relatively unused in the past when physical evidence of use is absent? Or are we correct in assuming that considerably more activity occurred than that for which we are able to find evidence? What implications does this have for the management of upland resources?

Although little can be done to record those prehistoric uses that do not alter the land sufficiently to be detected, more could be done to document historic and ethnohistoric uses of the highlands and extrapolate from these data to the expected physical evidence for such activities. This would permit assumptions to be made about the functions of some limited use sites now being found and permit an assessment to be made of how much more activity might have occurred on the landscape than is recorded in archeological evidence.

Modern ceremonial use of highland areas continues through the Southwest as well as elsewhere. New archeological sites are being created that would be valuable to document as a baseline for the future manager. The American Indian Religious Freedom Act requires the federal land manager to consider these ongoing ceremonial uses in a similar fashion to historic and prehistoric sites. Although the documentation and inventory of such sites and use would be helpful in understanding that aspect of land use that leaves little or no trace, there are inventory problems to overcome. Some ceremonial sites and activities cannot be recorded without adversely affecting the supernatural quality of the area and the associated ritual activity.

TRANSFORMATION PROCESSES

Although much has been written about transformation processes, high altitudes offer conditions that have had little archeological examination with respect to such processes. Generally environments at high altitudes are unstable, weather is extreme, and destructive forces are severe. The effects of these forces over time need to be evaluated and the results applied to what we know about the remaining archeological materials. It might well be the case that what initially appear to be ephemeral, limited use sites, are in actuality sites where considerable sedentary activity occurred.

The rate of decay in historic buildings is much accelerated in contrast to centuries old prehistoric sites and presents a unique problem for the land manager. The best time to document historic structures is prior to their collapse. Understanding historic use is easier where the buildings remain intact than when they have burned or rotted away. Dealing with historic properties, therefore, can be something of an emergency process. Techniques need to be employed and developed to do a more thorough job of recording and preserving historic information because of the possibility that it might not be available the next time we return. Historic wickiups found by chance may not wait for another season, or until special funds are available, or until a project is undertaken near them, to be recorded. Managers should be looking for inexpensive and rapid means of capturing and recording site data when the opportunity exists to do so. Stereographic photography is one means of quickly recording details that might otherwise take hours to record by manual methods. Experience in use of the technique could be invaluable for field crew members likely to need the skill. Although this situation exists for prehistoric sites as well, the accelerated rate of decay most historic sites are undergoing makes it particularly important to work out some method of recording and preserving existing historic data before more is lost to the forces of time.

SITE EVALUATION AND MANAGEMENT

Current regulations governing cultural resource management at the federal level provide for little flexibility in either the way the agency can meet the purposes of the law or in the variation of management treatments that can be prescribed. Under the regulations, cultural resources are either eligible or ineligible for nomination to the National Register of Historic Places. These are merely temporary states of a bifurcate classification system. The federal management prescription for such sites is clearly stated in regulation; sites not eligible for the National Register are not managed.

This division of the resource into two categories, one to be managed and the other to be ignored, has produced an overly conservative response by some agencies and has frustrated what some see as the basic purpose of the National Register. Many agencies have taken the definition of eligibility in its most conservative interpretation and have nominated all archeological sites to the National Register. In fact, by using thematic, district, and resource district nominations, all historic and prehistoric sites in an area can be listed on the National Register. Only rarely is a site excluded and then, frequently, after considerable expense for test excavations. The result of this situation is that every site, regardless of its simplicity or complexity, must be handled in the same way be following each of the outlined steps in the regulatory process.

The alternative is to consider only the major sites as eligible and consider the small, lithic scatters, cellar pits, and other marginal resources as ineligible for nomination. The danger posed by this approach is the absence of management direction for smaller sites. If there is any scientific, educational, or visual interest and value in these sites, it may not be considered or protected due to the absence of managerial directive for non-eligible properties.

The dilemma faced by the federal agency under current regulation is where to draw the line between two management classes of resources; this is a line that would seem to divide the resources into those to be protected and those to be forgone. On the one hand, a conservative division leads to the involvement of complex procedures each time a site of marginal value is threatened. The regulatory process frequently requires more effort to satisfy than that necessary to protect the site or mitigate the adverse effect of a proposed action. On the other hand, a less conservative division leads to the destruction of resources because of the absence of legal motivation to protect sites that are defined as not eligible for National Register listing.

Other ranges of values for cultural resources need to be recognized by the federal land manager. To list each resource as either eligible or not eligible fails to provide a satisfactory framework for allocation of this resource. Do all eligible sites deserve preservation and protection from any impact? Should eligible sites be considered appropriate research material or should they be protected for some future generation of archeologists? Should federal funds be expended in support of research on sites determined not to be eligible for listing in the National Register? What should managers do with sites that have scenic appeal but hold little scientific value?

These and other questions have led to several proposals for management frameworks that attempt to define a greater range of site categories that will allow the manager greater flexability in making decisions about resource allocation. These proposals are essentially systems of pigeon holes into which sites are put by assigning or identifying specific values and criteria.

One suggested framework, proposed by Dee F. Green at the High-Altitude seminar, is included here as an example of the expanded management classes offered by such systems. Some categories are the result of management actions and/or decisions. Other categories are defined by site characteristics. Still other classes are based upon changes in the status of sites either by natural means or as the result of some management action or inaction. Definitions of the criteria for making the decisions necessary to place sites into these categories remain to be written. What the framework provides is a system for determining resource allocation that is superior for management purposes, to the eligible-not eligible dichotomy of the National Register system.

<u>Cultural Resource Site Management Classes</u>

<u>I. Interpretive Use--Sites whose principle dominant uses are dedicated to a public demonstration of their value</u>.

A. Interpreted - Site has been signed, appears in brochure or other media such that the public is or can be made aware of its value. Tijeras Pueblo is an interpreted site because of a film and book now available describing the site. Sites recorded or reported only in a survey or excavation document are not interpreted.

1. Excavated and/or reconstructed/

restored/stabilized.

2. Excavated.

3. Unexcavated.

B. Uninterpreted - A site which has not been interpreted but a decision has been made to do so. It may be awaiting funds, design, or other action. Chavez Pass is an example of such a site.

C. Interpretive potential - Sites which have interpretive potential but no decision has yet been made to proceed with development. This category forms a pool of sites from which a manager may draw a site to move into categories I-A or I-B and remove it from this designation. Comment: Sites in this class may move to class VI or even to classes II and IV. In preparing interpretive material the site may be treated scientifically in order to derive the required interpretation without even being considered a member of Class III.

II. Living Use--Sites whose principle uses are dedicated to the needs of living cultures.

A. Religious/ceremonial sites (not restricted to American Indians).

C. Mortuary sites - Euroamerican cemeteries.

D. Other sites.

III. Scientific Use--Sites whose principle uses are dedicated to the recovery of knowledge about the past.

A. Available Immediately - Sites which are needed to answer current and pressing questions in order to insure the advancement of scientific knowledge.

1. PaleoIndian sites.
2. Archaic sites.
3. Pueblo sites or Formative Sites.
4. Historic sites.
5. Unknown sites.

B. Administrative sites - continued use of historic structures.

IV. Experimental Use -- Sites whose principle uses are dedicated to the recovery of knowledge about formation and destruction processes.

A. Formation Processes

1. Long term.

2. Short term.

B. Destruction Processes.

1. Mechanical.

2. Vandalism.

V. Preservation Use--Sites to be conserved for future uses.

A. Sites which should be re-evaluated in terms of class assignment in some future year (A.D. 2000?).

B. Sites which should be re-evaluated in terms of class assignment in a more distant future year (A.D. 2025?).

C. Sites which should be evaluated by some future time (A.D. 1990?).

VI. Removed--Sites whose principle values have been removed from the landscape.

A. Scientifically removed - Sites which were in Class III and have been removed and reported through either land disturbing or academic projects.

1. Surface collection.
2. Testing.
3. Total or near total excavation.
4. Destroyed.

B. Administrative Action - Sites which have been removed through administrative actions. Mitigation may or may not have occurred prior to removal.

C. Illegal Causes - Sites removed due to illegal activities.

1. Surface collecting.
2. Digging.
3. Inadvertant actions.

D. Natural Causes - Sites which have been removed through natural causes such as erosion.

1. Removed.
2. Buried.

VII. Sites Now Being Created--These are

buildings, trails, roads, and other in-use sites that must be documented.

By offering a variety of designations for cultural resources, the manager can use the above framework to weigh specific sites in advance of proposed undertakings. The eligible-not eligible dichotomy could still be used when necessary, but would become less important as a management tool.

CULTURAL RESOURCE COMPLIANCE

Another important step that agencies could take in the area of cultural resource management would be to break away from the strict compliance with regulations on a project by project basis and begin to exercise more options to resource consideration. It is clear that not all sites are being protected through the application of existing regulations. Some sites are not found until too late, some undertakings proceed without adequate investigation due to limitations on staff and funds, and some resources are mangled in mitigation. Other approaches might result in a better track record when it comes to the protection of significant resources.

Some of the mangement options that could be tried are: (1) establishment of archeological or historical areas to protect representative samples or areas of cultural resources, (2) regional cultural resource research designs and planning, and (3) adjusting inventory intensity to site frequencies and project impact potential.

The establishment of areas of known or predicted archeological or historical value could allow the manager to identify the priority of uses and prepare a management plan to guide any activities anticipated for those areas. It might also permit the relaxing of compliance requirements for other areas which are known to contain very similar examples of historic and prehistoric resources. Providing for a high standard of preservation for a drainage or mesa could possibly allow a lesser standard to be adopted for a similar situation in the same area. By lesser standard, we mean that decisions to mitigate adverse impacts would be acceptable in the non-designated area where they would not be acceptable in the designated area. Deterioration of structures would be allowed in one management area but stabilization would be carried out in another.

Increased understanding of regional cultural systems might permit more rapid evaluation of individual sites, the reduction of evaluation costs, and a reduction in the need for extensive mitigation. By stressing the understanding of the whole system rather than just a specific site, determinations of site significance can be made more reliably. Instead of worrying about the relative importance of a single lithic scatter or an isolated cabin, information about the numbers and kinds of sites in the area could assist in placing the proper evaluative perspective on the problem. This approach is difficult to achieve given the current emphasis on strict compliance with regulations on each and every project.

By correlating intensity of inventory to the potential impacts and the potential frequencies of sites in an area, the manager could continue to control the amount of risk taken while making his funds and staff time stretch further. By stressing statistical sampling, a reliable data base could be built that would not only permit the adjusting of inventory coverage, but would also provide more reliable data for assessing regional patterns. The result would be an increase in knowledge about the resource with about the same level of cost and risk taken by the manager. This approach might not be legally possible, however, given current regulatory requirements.

REGIONAL RESEARCH

One of the several problems faced in addressing total cultural systems is the political boundaries that tend to relegate high elevations to the Forest Service and the lowlands to either the Bureau of Land Management or to State, local, and private groups and individuals. If the ultimate understanding of the processes that resulted in the creation of high-altitude archeological sites hinges on the information contained in lowland sites, the cooperation of several agencies will be essential. The Pueblo field houses on Elk Ridge, southeastern Untah, seems logically related to the lowland streamside villages located on Bureau of Land Management and state lands. As long as the Forest Service is limited to the examination of resources on the lands it manages, there may be no satisfactory solution to problems of settlement patterns and land uses in the

past. Although the 1906 Antiquities Act provides authorization to federal agencies to investigate adjacent lands, the emphasis upon strict compliance with regulations has not allowed much opportunity to exercise this option.

An appropriate vehicle for coordinating interagency research and investigation is needed. It was felt by some of those participating in the seminar that the state historic preservation plan might serve as a means for coordinating efforts and channeling research into mutually supportive directions. Recent events seriously threaten the future of any such planning effort. Federal funding for support of state inventory and planning efforts is being threatened with elimination. With the disappearance of federal funding, many states will be forced to close their State Historic Preservation Offices and end work on state historic plans.

Another possibility for interagency cooperation would be for the agencies and states to form research groups to coordinate and channel efforts into cooperative projects. Groups similar in makeup and in aims to the Southwestern Anthropological Research Group (SARG) could be useful in achieving some regional research focus and goals. As with SARG, however, funding for a centrally focused research approach could be a problem. In spite of the problems, such cooperative efforts would be better than doing nothing or continuing with the piecemeal and individual approaches now being taken.

EVALUATING HIGH-ALTITUDE SITES

There are a number of specific issues that were raised during discussions that bear on the evaluation of high-altitude cultural resources. The amount of high-altitude land and its distribution varies widely throughout the southwest. It would be of interest to determine what effect this size variation in mountain mass had on the distribution of historic and prehistoric populations. Does the large size of the Markagunt Plateau account for the relatively high frequency of archeological sites found there? It is expected that one would find a greater abundance of exploitable natural resources at high-altitudes in a large mountain mass than one would find in a small highland area. This variation in resource abundance may drastically alter the patterns of use. In a small highland area there might not be sufficient of a resource to satisfy the needs of an adjacent population or justify its exploitation; therefore, that need would be satisfied elsewhere, or in some other manner. In addition to the inventory of archeological sites in highland areas, more data is needed on the highland's potential resources, particularly food resources, and their relative abundance and seasonality. This information might provide clues as to the patterns of highland resource utilization. In spite of the rather nebulous character of many highland sites, there remain a great many techniques for extracting additional data from these areas that have not been utilized. Identification of mineral resources by their source and their distribution in the cultural context could be extremely useful in defining patterns of use. Hydration dating of obsidian and ignumbrite gives considerable promise for increasing chronological control of sites in those areas.

DOCUMENTING ETHOHISTORICAL USE

Another area that deserves additional attention is the documentation and study of ethnohistorical use of high-altitudes. Such studies could suggest functions for some of the sites that have been located and address the problem of uses that leave little or no physical evidence. These data would also be useful to the manager in determining what current uses by American Indian groups are based upon long tradition and what range of past and present uses can be expected to occur. Religious utilization of high elevations is common among many native American groups, but the documentation of these uses is poor. The requirements of the American Indian Religious Freedom Act direct land managers to address this issue of traditional religious use of federal lands. Ethnohistorical research is of vital importance to both archeological interpretation and to the land manager's compliance with this Act.

TREATMENT OF ISOLATED ARTIFACTS

The policy for handling isolated artifacts needs examination. Conference members suggested that such isolated finds might show distributional patterns that could yield useful archeological data. Some Forest Service units are not treating

isolated objects in a manner conducive to distributional study at more than a very general level. In Region 4 of the Forest Service, for example, isolated finds were often recorded by location on project maps or aerial photographs, but were accessioned separately from site information. This makes it much more difficult to integrate data from such isolated finds into the evaluation process applied to sites. Although the information from one or two isolated projectile points found in a single project is often of minimal value, reassessing the information after a decade of projects has shown that isolated projectile points from a specific area may now number in the hundreds. If adequate control over these data is established, re-evaluation of isolated finds can be carried out much more efficiently than by trying to relocate each specimen in the collections and re-establish its provenience data. For example, each inventory project in the Pine Valley Mountains of southwestern Utah located a few small lithic scatters, some containing projectile points, a few isolated points, and little else. Each project evaluation had little to say about cultural association or chronological context. After 10 years of these small projects, a brief re-evaluation indicated that several hundred sites had been located along with hundreds of projectile points, many of obsidian. Now a great deal more can be said about cultural and chronological contexts. A framework for establishing criteria that the land manager could use in making site evaluations is now possible for the area.

It is important that land managing agencies build into their programs the means and motivation to periodically reassess the cultural resource data they are collecting. Such reassessments will help to highlight methods of improving collection techniques, data recording, storage and retrieval methods, etc. It will also provide the opportunity to re-evaluate all available information as it applies to the cultural resources being inventoried. This might permit a refinement of the criteria being used to determine what sites should and should not be conserved, receive mitigation, etc. It will also provide the means for evaluating the program results and making improvements in operating efficiency.

FEDERAL POLICIES ON MANAGEMENT OF HIGHLAND AREAS

There has been an element of confusion within the Forest Service concerning the interrelation of cultural resources and the management of designated wilderness areas. A number of discussions have been held in an attempt to define the impact of each resource on the other (Green 1975, 1979). Some managers feel that since cultural resources do not belong in Wilderness, the most obvious ones must be removed. As a result, cabins have been demolished and burned, fire lookout towers have been dismantled and removed, and structures have been allowed to deterioriate. Although most of the present concern lies with historical structures within wilderness areas, the problem also concerns archeological materials. Can archeological research, i.e. excavations, be carried out in wilderness areas? Can stablization and restoration of threatened prehistoric structures be allowed? Does wilderness designation provide more protection to cultural resources than other forms of land use designation, hence making inventory of resources in such areas unnecessary? Although the objective of wilderness classification is the conservation of an environmental setting, can it and does it include the conservation of historical and prehistorical resources?

All of these questions have been and are being asked. How they are answered may have important consequences for future archeological activities in highland areas. Since most of the designated wilderness areas of the west encompass highland areas, research into high-altitude archeological phenomena will be directly and significantly affected in many areas. If a management decision was made by the Forest Service to prohibit any archeological excavation in wilderness areas of the West, the total resource base available for highland research would diminish significantly. Of more immediate concern is the tendency to de-emphasize the need for wilderness cultural resource inventories and the long term effect of a continued lack of knowledge about the resource base in these areas.

Only the Hells Canyon and River of No Return Wilderness Acts provide specific direction to undertake some degree of cultural resource inventory as a basis for

preparing the management plans for the areas. Other wilderness areas will likely receive very low priority for inventory unless the legislation designating them as wildernesses contains similar provisions. The situation is resulting in the removal of significant amounts of land, land we know very little about archeologically, from any federally funded inventory work in the forseeable future. No provisions are being made for wilderness inventories of historic and prehistoric resources in Forest Service budgets over the next five years and, unless the situation changes, no provisions will be made for the next decade at least. Even in those cases where there is specific language in the legislation creating the wilderness, allocating funds for the inventory work is not an easy matter. In spite of the direction to carry out historical and prehistorical inventory as part of the River of No Return Wilderness, funding has been minimal and compliance with legislated directives will be unlikely.

CONTROLLING SCIENTIFIC USE

One of the very real problems with current archeological research on federal lands is the concern of archeologists with the control of scientific research by federal managers. Although this is mostly a western problem, it is not restricted to high-altitude research alone. Agencies, particularly in the western United States, control access to most of the land base upon which the cultural resource occurs. In addition, the growth in emphasis upon environmental impact related cultural resource work has diverted a major portion of archeological research effort over the last decade into federally administered programs.

The perception of low status attached to the government archeological position, common prior to the 70s, has been altered as more and more of the available funding and research opportunities have shifted to the federal sector. Federal specialists have steadily been gaining economic and political power when it comes to deciding which research proposal will be funded and what is perceived as good and necessary research and technique. This shift of focus from the academic to federally initiated activity has had a number of important consequences.

It has become fashionable to seek and accept federal positions in archeology or cultural resource management. There has been a virtual explosion of small private archeological companies interested in obtaining Federal contracts to carry out "cultural resource management" work. Contract offices have been established at more and more academic institutions, providing expanded opportunities for students to become involved in "cultural resource management" work. Contract offices have been established at more and more academic institutions, providing expanded opportunities for students to become involved in "cultural resource management" projects. Staffs of specialists in federal and state agencies have expanded drastically over the past decade. For example, the Forest Service expanded its archeological personnel from three individuals in 1970 to 140 by 1980. Other land managing agencies have experienced similar if not greater increases in archeological personnel. This expansion of cultural resource management programs has drastically affected the agencies involved as numbers of personnel, projects, and costs have expanded almost exponentially in a decade. A $50,000 annual program in 1971 had grown into a $10,000,000 program in the Forest Service by 1981.

Expansion of the regulatory process within which federal agencies carry out their missions has also occurred. The flurry of regulation writing, agency manual revision, administrative directives, and other types of instructions and guidelins has been intense. The result of much of this regulatory process has been the increasing control of federally-funded research and investigation. It has even been suggested in some quarters that all federally-funded and permitted archeological research be directed to specific national research goals. It is clear that more cooperation will be demanded of the federal, academic, and state archeologists if we are to be successful in investigating regional issues and problems while maintaining a high level of individual freedom to select and pursue specific research goals and interests. These issues are particularly applicable when it comes to doing research in highland areas of the West.

IMPROVING COOPERATIVE RESEARCH

More effective mechanisms similar to that

employed in the Southwestern Region of the Forest Service (Green and Plog 1982) are needed for involving non-agency archeologists in the decisionmaking process about cultural resource allocation. The existing system revolves too tightly around a formal compliance process that addresses resource allocation only when it is being threatened with direct federal action. The compliance process does not face issues of long-range cultural resource conservation and allocation. Are there sites present in a particular project that should be given priority consideration for preservation from all disturbance including archeological excavation? Are there sites that should be investigated as a means of increasing scientific knowledge and improving the agency's abilities to evaluate other sites? These are questions that are of importance, not just to those within the agency but to the entire archeological community.

Under the current system, Federal archeologists talk to State Historic Preservation Office (SHPO) archeologists when they must. Both Federal and SHPO archeologists talk to Advisory Council archeologists when required. When occasional outside advice is needed, Interagency Archeological Services archeologists are contacted by some agencies. As a result, this system is frequently exclusive of any other broader archeological interests. Efforts to maintain contact with these other worlds of archeology, contracting and academia, are frequently frustrated by geographical isolation, limited travel opportunities, funding limitations, and low priorities within agencies for professional maintenance and development.

For example, an archeologist hired by the Forest Service might be stationed in Elko, Nevada. His closest peer might be in Salt Lake City, Reno, or Pocatello, locations which he seldom gets a chance to visit due to travel limitations. No one working in the same office has a similar professional interest, and if the archeologist possesses a graduate degree, he might find himself viewed as an outsider, and an "intellectual." Discussions with the Forest staff is limited to compliance issues. Seldom is one afforded the opportunity to concentrate on issues of scientific interest except as they relate directly to inventory, evaluation, mitigation, and compliance. Time and money are in short supply and the workload is heavy.

As a result of this situation, many federal archeologists feel they are isolated from the profession, cut off from the mainstream of the discipline, and viewed by others in the profession as somewhat less than competent. Attendance at regional and national archeological gatherings is a rare opportunity, since the archeologist is dependent upon the availability of travel funds and such meetings are not usually considered as "part of the job" by supervisors. Land management agencies should be concerned with this situation as well, because of the parochial attitudes and views that can result from this isolation. The cost of such narrow views might far outweigh the travel costs.

One of the common complaints heard from Forest Service archeologists is the lack of professional opportunities and training within the agency. Meeting high output targets with limited budgets places a strain on everyone in the agency, but it is recommended that agencies take a careful look at the costs involved. It is likely that this situation is resulting in higher unit costs than necessary. Keeping in touch with others in the professional community and keeping active professionally will result in increased skills and innovative procedures and techniques that might otherwise be misused. Close communication with other segments of the archeological community lends to increased confidence and cooperation and reduced conflict over issues. The result is greater efficiency and effectiveness of the cultural resource management program.

STATE PLANNING

Up until the portending demise of the State Historic Planning Grant program, it seemed that the state plan offered an opportunity to focus the interests of all archeologists in a particular area. The state plan, the responsibility of the State Historic Preservation Officer, was designed to direct and define areas of interest in historical and archeological research within the state. Federal agencies are charged with cooperating with the SHPO for both compliance issues and other longer range issues. By working to include contract and academic archeologists in this cooperative process, a mechanism could be devised to define issues and suggest directions that

would be of mutual interest and benefit. The State Historic Preservation Plan could then be the framework within which resource allocation decisions faced by the land managing agencies could be made. The state plan could incorporate the views and interests of archeologists from all sides and then function as the interface with Forest Service forest and regional plans or with similar planning efforts in other land managing agencies.

IDENTIFYING AND MANAGING ETHNIC USE

High elevations have played an important role in traditional religious and ceremonial uses for thousands of years throughout the world. The management of high elevations in the Southwest must take into consideration the continued use of these areas by Native Americans. The passage of the American Indian Religious Freedom Act in 1978 gave additional impetus to the concerns of ethnic groups about their access to public lands for ceremonial purposes. It has also given additional dimensions to the problems of cultural resource management. The impacts of federal actions on the religious and ceremonial structure of Native Americans must now be specifically addressed.

Identification of continuing use of high elevations by Native Americans can be a complex problem. Ceremonial use can take a number of different forms, such as:

a) sacred locations, shrines, objects, etc.,
b) sacred areas,
c) ceremonial gathering of special resources, and
d) environmental settings necessary to spiritual conditions.

Locationally specific ceremonial uses can be handled in much the same manner as prehistoric and historic sites. Each location can be identified and given appropriate management consideration. Sacred areas are much more difficult to deal with, however. In many cases entire mountains, canyons, or other large topographic land units are significant to traditional religious systems. The size of the sacred area is so great that treating it in a special manner would present some extremely difficult legal and resource management problems. Already several complex issues have arisen over this type of ceremonial usage and in the next few years litigation will undoubtedly set the legal precedents and parameters for the managing of federal lands in compliance with this law. The constitution guarantees that the government will "not interfere" with religions but it also cannot actively promote any religion. Setting aside areas specifically for religious use would violate that principle.

Ceremonial usage that involves collecting special resources and certain environmental settings that are conducive to supernatural experiences present a different type of management problem. As long as these resources are available and these required settings are accessible, their specific location might not be critical. A vision quest might be possible in any of several remote areas provided that the setting is correct and conducive to the experience being sought.

Many Indian groups see any destruction and disruption of the physical landscape as an adverse effect upon the supernatural world. The closer this disruption comes to locations of great ceremonial significance, the greater the negative effect. Actual destruction of a shrine is the maximum adverse effect. This range of adverse impact must be understood by the land manager if he wishes to avoid serious conflicts with traditional Indian groups. Because of the variation in the amount of adverse impact, projects could be carried out in some areas without any outcry from the Indian community and then, seemingly without warning, a serious objection to a similar project can develop because of the involvement of an especially important area or location.

An important thing to consider in project planning is that attitude and method must be in harmony with traditional belief systems and practices. Projects carried out with concern for and consideration of traditional beliefs may be accepted when the same project proceeding without such sensitivity might generate serious opposition. For example, excavation and removal of burial offerings is carried out by native Yucatec Maya even though they realize that they are upsetting supernatural forces. Offerings of candles and food are made during the excavation to appease the spirits and help restore the supernatural balance upset by that

activity. When environmental disturbance occurs that affects areas believed to be supernaturally powerful, the land manger is in the greatest danger of invoking Native American opposition. Properly handled, much of this opposition could be overcome or diminished.

Ceremonial use of high elevations continues throughout much of the nation. Identifying that use is complicated by its very sacredness. Some important locations cannot be inventoried by non-Indians without adversely affecting the spiritual character of the location. Although the land manager is directed by the American Indian Religious Freedom Act to give consideration to such uses, the act of documentation may be difficult due to the difference in status between "believers" and "non-believers." There are locations which must remain secret from non-participants in order to be useful in ceremonies. Therefore, Native Americans may be reluctant to reveal the locations of important ceremonial sites.

Examples of existing problems point up the potential for conflict over modern ceremonial usage and between public and traditional value systesm.

It is expected that the next five years will see a number of legal proceedings that will set the tone for management in this area for some time to come. It is anticipated that some of the fallout from these cases will affect the practice of archeology on federal lands.

SUMMARY

The ideas and concepts expressed by the participants in this volume and during the course of our stay at the School of American Research in Santa Fe will have a lasting effect upon those present. Many of these concepts are currently being translated into agency policy and procedures. Efforts are being made to implement many other ideas developed in order to bring the Federal cultural resource program goals into closer alignment with scientific goals. Efforts are being made to act upon many of the suggestions made by various participants to improve the quality and quantity of cooperative approaches to common goals. The success of archeological research with highland sites in the Southwest will depend heavily upon the degree of success we have in developing an effective cooperative effort between federal, state, and private groups.

Although the impact of federal cultural resource management has generally been favorable over the last decade, the political arena is always subject to rapid and widespread changes in policy and attitudes. Archeologists and archeology remain vulnerable to these changes through a lack of constituency, an unclear public purpose, personal differences between colleagues, and an all too common negative attitude among public land managers. We are seen as a special interest group and our needs are weighed against other special interest groups, some of which can demonstrate a more urgent and directly useful public benefit.

Much of the progress in cultural resource management over the past decade has been the result of the federal regulatory process. The law requires cultural resource management consideration on the part of the land manager. Over the next decade we must be careful to avoid excess, unnecessary expense, unreasonable research, and fuzzy thinking when it comes to publically sponsored archeological research. A much better job of resource management is needed and the Federal agencies are looking to the archeologists for help in designing programs that will conserve the resource, and assist the manager in making the difficult decisions about resource allocation and in defining how much data should be recovered when threatened impacts cannot be avoided.

If the archeological community is successful in defining a reasonable and scientifically sound program for application to the cultural resources of the highland West, as well as elsewhere, it can be expected that public archeology will weather the economic storm created by political changes. If it cannot, Federal and State archeological programs are liable to face a period of serious challenges over the next decade. From the perspective of the federal cultural resource management program, the value of this seminar lies primarily in the degree of cooperation attained by the participants in addressing issues of archeological importance and of use to federal and state land managers.

It would be my recommendation that other such sessions be held to address other issues of state, local, and national

significance. Intensified cooperative efforts between the academic and agency professionals are needed to establish priorities and set goals and targets toward which all could work. The result would be beneficial to all participants and to the public resource with which we are all concerned.

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